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H. W. WILEY, Chief of Bureau.

THE FEEDING VALUE OF CEREALS,

AS CALCULATED FROM CHEMICAL ANALYSES.

By

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In Collaboration with the Bureau of Plant Industry.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., October 23, 1908.

Sir: I have the honor to transmit for your inspection and approval a manuscript containing the results of a chemical study of the feeding value of certain cereals, especially oats, wheat, and barley, recently completed in the Cattle-Food and Grain Laboratory of this Bureau in collaboration with the Bureau of Plant Industry. I recommend that this report be published as Bulletin No. 120 of the Bureau of Chemistry, its strictly chemical nature suggesting this arrangement, which has the approval of the Chief of the Bureau of Plant Industry.

Respectfully,

H. W. Wiley,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

LETTER OF SUBMITTAL.

U. S. Department of Agriculture,
Bureau of Chemistry, Miscellaneous Division,
Washington, D. C., October 1, 1908.

Sir: I submit herewith a report on the feeding value of cereals, by Joseph Chamberlain, Chief of the Cattle-Food and Grain Laboratory of the Miscellaneous Division, acknowledgments being due to Mr. H. W. Houghton, assistant chemist, who performed the analytical work on a portion of the samples examined, and to Mr. T. C. Trescot, in charge of the Nitrogen Section of the Bureau of Chemistry, who made the nitrogen determinations. The work was done in collaboration with the Office of Grain Investigations of the Bureau of Plant Industry, having been begun there by the author prior to his transfer to the Bureau of Chemistry. The report discusses the relation between the chemical composition of cereals and their nutritive value, as well as the comparative value of certain varieties of cereals recently introduced.

Respectfully submitted.

J. K. Haywood,
Chief, Miscellaneous Division.

Dr. H. W. Wiley,
Chief, Bureau of Chemistry,
U. S. Department of Agriculture.

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THE FEEDING VALUE OF CEREALS AS CALCULATED FROM CHEMICAL ANALYSES.

INTRODUCTION.

The chemical analysis of grains and other materials used in feeding domestic animals consists in the determination of the nutritive substances contained therein. The results of such determinations are expressed in percentage amounts, usually, as pounds per 100 pounds. From these determinations the value of the food for feeding purposes is obtained.

The essential nutritive materials contained in all foods are comprised within the three classes of substances, proteins, fats, and carbohydrates, and the determination of these is the object of a feeding-stuff analysis when its food value is desired. In order that the results of various analyses may be directly comparable the moisture content of the food is found, and from this the amounts of the other constituents are calculated to a uniform water-free, or dry, basis. Another determination is also made, namely, that of the ash or mineral matter. The mineral substances present in a food play an important part in the physiological process of digestion, but possess no value as a direct source of energy. Their action is mainly indirect, and as no method of measuring their value is known, they are not considered in calculating the nutritive value of foods. The usual form, therefore, of expressing the results of an analysis of a stock food is to give the amounts of the following substances present: Water, ash, protein, fat, and carbohydrate; the food value of the material being based on the last three.

In the study of such complex materials as feeding stuffs, however, it has been found that a knowledge of the total amounts of these three nutritive constituents is not sufficient to give an exact idea of the food value of any substance. This is due to factors depending, first, on the character of the food itself and, second, on that of the animal using it. The three groups of substances—proteins, fats, and carbohydrates—do not yield all of their material to the animal as nutriment, nor are they nutritive in equal degrees. The proportion that is actually digested and used by the animal is different in each case, i. e., each possesses a certain coefficient of digestibility. Furthermore, each of these groups as ordinarily determined contains separate and distinctly different substances which, under certain conditions or when present in small amounts, may be disregarded, but which, when present in large amounts or when productive of decided effects, even though in small quantities, must be considered separately.

NUTRIENTS ON WHICH THE FEEDING VALUE IS BASED.

PROTEINS.

This class of substances includes the true proteins, which are of an organic nitrogenous nature, very complex and similar in composition and properties to white of egg or lean meat. They are of very great importance, for from them the animal derives the nitrogenous material from which its own muscular tissue is built. The separation of the proteins into individuals or even into classes is very difficult and, though they are not all equal in nutritive value, the investigations throwing light upon this question are so recent and incomplete that it is impossible, at present, to attempt any separation. With vegetable foods the proteins may be left as a group, because those present are the simple proteins and are similar to each other.

There is, however, another class of nitrogenous organic bodies which are not proteins, but which are included with them in determinations made by the usual methods. These substances are the amido compounds. Many of the proteins contain approximately 16 per cent of nitrogen, and it is customary in analyzing protein foods to determine simply the amount of nitrogen present. The result obtained by multiplying this amount by 6.25 is called crude protein. When determined in this way, crude protein includes the amido compounds, which do not contain as much nitrogen as the proteins, nor do they furnish as much, if any, nutriment to the animal. In cereal grains the amount of these amido compounds present is very small, even within the limits of error of the method of separation used,[a] and on this account they are disregarded and the crude protein is considered as true protein.[b]

FATS.

The method for the determination of fats is that of extraction with ether, and all substances soluble in ether, such as chlorophyll, organic acids, waxes, resins, etc., are included. In some materials allowance would have to be made for such a mixture, but in grains and a great number of ordinary stock foods it is not necessary. The extracted product is not always a pure fat or a mixture of pure fats, but when waxes or resins are present they are in small quantities and their nutritive value is probably almost the same as that of true fats. No great error is introduced, therefore, if the extract is considered as fat, and this is usually done. On account of the impure nature of the extract, the name "ether extract" is often used instead of the term

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[a] Stutzer's method.

[b] The protein factor used in this investigation, except in the case of wheat, is the common one, viz, 6.25. With wheat the now accepted factor of 5.7 has been adopted.

"fat." In this bulletin, however, the term "fat" is used to signify the crude product obtained by the ordinary extraction of the dry material with anhydrous ether.

CARBOHYDRATES.

In an ordinary analysis of stock foods or similar material all those substances left after the ash, protein, and fat have been determined are included in the term "nitrogen-free extract" and considered as carbohydrate. In materials containing much sugar or when it is desirable to know the amount of starch, as such, these constituents are determined separately. In cereal grains, excepting sweet corn or saccharine sorghums, the amount of sugar is not great and starch is practically the only carbohydrate present. In such cases no separate determination of these substances is made and the total carbohydrate is determined only by difference, i. e., 100 per cent less the amount of ash, protein, and fat combined.

In many vegetable products, however, a considerable portion of this nitrogen-free extract or carbohydrate remainder consists of fibrous material, such as hulls, stalks, and the cellulose portions of plants generally. This material, though a true carbohydrate in nature, has a distinctly different coefficient of digestibility as compared with sugar or starch, and must therefore be considered separately. This coarse fibrous portion of vegetable foods is termed "crude fiber," and though only slightly digestible it plays a very important part in digestion. It acts as a dilutant of the more concentrated portions of the food, such as starch, necessitates for the whole food thorough mastication, and prevents it from becoming too compact; in other words, it keeps the food mass porous and open to the action of the digestive fluids. If, however, the amount of this crude fiber or roughage is in excess, as in the case of coarse fodders, the amount of energy expended by the animal in securing and digesting the food is so great that its ultimate nutritive value is correspondingly diminished. That part of the crude fiber which is digested has, however, the same nutritive value as the other carbohydrates, so that, except as regards digestibility, the crude fiber is considered with the other carbohydrates.

Another carbohydrate substance, in addition to sugar, starch, and crude fiber, is sometimes considered separately, namely, the pentosans. These are compounds related to the sugars, being polymeric forms of five carbon sugars. Their digestibility and nutritive value, according to Kellner,[a] are nearly the same as those of starch, and consequently a separate determination is not necessary. When sugar is present in any considerable amount it must be determined separately, as its nutritive value is slightly different from the other carbohydrates.

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[a] Kellner, Die Ernährung der landwirtschaftlichen Nutztiere, 1905, pp. 88, 153.

The remaining substances sometimes present and included in the nitrogen-free extract, namely, the organic acids, are seldom found in sufficient amount, especially in ordinary fresh foods, to make their consideration necessary.

CLASSIFICATION OF ALL SEPARATIONS.

On account, therefore, of differences in digestibility or in nutritive value, the analytical separation of a feeding material as previously given must be enlarged to include part or all of the following substances:

- Proteins:
  - True proteins.
  - Amido compounds.
- Fats:
  - True fats.
  - Waxes, resins, organic acids, chlorophyl, etc.
- Carbohydrates:
  - Sugars, starch, pentosans, and organic acids.
  - Crude fiber.

In the case of cereal grains and similar materials this classification for separation may be condensed, because of the small amounts of most of the secondary constituents which are present, as follows: Protein, fat, crude fiber, carbohydrate. In the present investigation these are the determinations that have been made.

FACTORS USED IN CALCULATING FOOD VALUES.

COEFFICIENT OF DIGESTIBILITY.

The separation of the nutritive constituents of foods into the groups or classes just described is made because of the differences in their relative digestibility. The effect of the general nature of the food on its digestibility must also be considered. Each of the nutritive constituents, protein, fat, crude fiber, and carbohydrate, has a coefficient of digestibility which differs for each food in which it occurs. Therefore the coefficient of digestibility of each of these constituents must be known for each food under consideration. Such coefficients have been determined by actual feeding experiments on living animals and factors of digestibility calculated from the results. It has also been shown that it is necessary to consider the animal itself as well as the food and the individual constituents. Such experimental results can not be obtained in all cases, but they have been secured by a few investigators for the more common domestic animals and for a considerable number of foods. From the results of such direct experiments the general factors thus obtained may be applied to a variety of foods. The results obtained by Kellner at the Möckern experiment station are considered reliable and have been used in the present investigation. The coefficients of digestibility as given in his tables [a] may be illustrated as follows:

When oats are fed to horses the following amounts are digested:	Per cent.
Protein	80
Fat	71
Crude fiber	29
Carbohydrate	75
When fed to mature fattening cattle the amounts are:	
Protein	78
Fat	83
Crude fiber	26
Carbohydrate	77

If these coefficients are applied to a particular case—for example, a sample of oats—the following percentages of the nutrients are found to be available under the conditions specified:

TABLE I.—*Digestibility of oats for horses and cattle.*

Nutrient.	Total.	Digestible.	
		For horses.	For mature fattening cattle.
	Per cent.	*Per cent.*	*Per cent.*
Protein	12.80	10.32	10.06
Fat	4.15	2.95	3.44
Crude fiber	12.53	3.63	3.25
Carbohydrate	66.58	49.94	51.27

These figures express the mean results of actual feeding experiments and, while variations will necessarily be introduced by each individual animal, they may still be considered as giving fair average results applicable in ordinary cases.

The following tables give the coefficients of digestibility used in this bulletin, the amounts of crude nutrients as found by analysis, and the digestible nutrients as calculated from these:

TABLE II.—*Coefficients of digestibility.*

[For mature fattening cattle.]

Grain.	Protein.	Fat.	Crude fiber.	Carbohydrate.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Oats [b]	78	83	26	77
Emmer [c]	75	71	44	75
Einkorn [c]	75	71	44	75
Wheat [d]	84	63	47	92
Rye [b]	84	64	53	92
Barley [b]	70	89	33	92
Proso [e]	49.2	76.9	68.3	85.2
Sorghum [f]	65	70	51	91
Maize [b]	72	90	41	95

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[a] Kellner, Die Ernährung der landwirtschaftlichen Nutztiere, 1905, pp. 561, 569.
[b] Ibid., p. 569.
[c] Ibid., p. 561, "Spelzweizen."
[d] Ibid., p. 561.
[e] Tangl, Landw. Jahrb., 1905, *34*: 1, "Besenhirsekorn" fed to oxen.
[f] Kellner, ibid., p. 569, "Dari."

Table III.—*Total and digestible nutrients.*

[Pounds per hundred pounds.]

Grain.	Protein.		Fat.		Crude fiber.		Carbohydrate.	
	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.
Oats	13.76	10.73	4.33	3.59	12.20	3.17	66.39	51.04
Emmer	13.28	9.96	1.91	1.36	11.31	4.98	69.42	52.06
Einkorn	14.67	11.00	2.19	1.55	13.55	5.96	64.02	48.04
Wheat	14.20	11.93	2.36	1.49	2.78	1.30	78.72	72.42
Rye	13.44	11.29	1.83	1.17	2.30	1.22	80.24	73.82
Barley	13.39	9.37	1.87	1.66	5.64	1.86	76.05	69.96
Proso	12.77	6.28	3.27	2.51	8.95	6.11	71.23	60.69
Sorghum	11.71	7.61	3.25	2.27	1.80	.92	81.58	74.24
Maize	9.91	7.14	4.40	3.92	2.21	1.28	81.96	77.86

CALORIFIC VALUE AND METABOLIZABLE ENERGY.

When the nutrients of food are utilized within the animal body, the ultimate product is either flesh or energy. The unit for measuring this flesh or energy-producing power of a food is the unit of heat energy or the calorie and the value so obtained is termed its calorific or fuel value.

The actual measurement of this calorific value is made in an instrument called a calorimeter, in which an exact amount of substance (e. g., one of the nutrient constituents of foods, such as fat) is burned in an atmosphere of oxygen and the amount of heat so generated is measured and expressed in calories.

When 1 gram of water is raised 1° C. in temperature, the amount of heat used is called a calorie. As this unit is too small for most purposes, it is multiplied by 1,000; that is, the amount of heat required to raise the temperature of 1,000 grams or 1 kilogram of water 1° C . In English units this is equivalent to the amount of heat required to raise the temperature of 1 pound of water 4° F. This unit is called the large Calorie, and is written capitalized to distinguish it from the small calorie.

The total calorific value of a food is equal to the sum of the calorific values of the different nutritive constituents. The entire food is, however, not utilized by the animal, and the calorific value of each nutrient must be determined not on the total amount of nutrient present, but only that part which is digestible. Also, in the processes of digestion there are formed certain intermediate waste products that still possess potential energy, and the energy of the digestible portion of the food must be corrected by the amount of energy in these waste products in order to determine the true amount of energy in the food actually utilized by the animal. This resultant energy utilized by the animal has been termed available energy or, better, metabolizable energy.[a]

The loss of energy due to waste products other than undigested food varies with different animals and with each of the nutrients, so that the corrections necessary can only be made after direct experiment. Such experiments have been made upon carnivorous animals (dogs) by Rübner, and his results giving the available or metabolizable energy of each of the three groups of nutrients have been accepted and applied to other animals as well. Within recent years, however, Kellner and others have carried out experiments with other animals, especially herbivorous animals, and it has been found that the figures given by Rübner for dogs do not apply to herbivorous animals. Kellner's work was with mature fattening cattle, and the following table gives the total calorific value and metabolizable energy in Calories per pound for each of the three groups of nutrients as found by Kellner and the metabolizable energy as found by Rübner. In Kellner's work the corrections were made on the values for wheat gluten as protein, on ordinary ether extract, and on starch as carbohydrates.

TABLE IV.—*Metabolizable energy of nutrients per pound.*

Nutrient	Cattle (Kellner).		Dogs (Rübner)
	Total calorific value.	Metabolizable energy.	Metabolizable energy.
	Calories.	*Calories.*	*Calories.*
Protein	2,720	2,220	1,860
Ether extract	3,780	3,780	4,220
Carbohydrates	1,900	1,710	1,860

These figures mean that for every pound of protein digested by cattle 2,720 Calories of energy are produced, but only 2,220 Calories are really available from the food metabolized by the animal for the production of energy or flesh. From the ether extract 3,780 Calories of energy are produced for every pound digested, and of this the entire amount represents metabolized food. The carbohydrates possess 1,900 Calories per pound of total energy, while only 1,710 Calories are yielded by the food really metabolized.

From Table III (p. 10), which gives the amount of total and digestible nutrients, the energy yielded by the metabolized food for the production of animal energy or flesh can be calculated. The following table gives the total nutrients, digestible nutrients, and metabolizable energy. The last is calculated both according to the figures of Kellner and of Rübner, for the purpose of comparison:

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[a] Armsby, Principles of Animal Nutrition, 1906, p. 270.

TABLE V.—*Metabolizable energy.*

[Pounds per hundred pounds.]

Grain.	Protein.				Fat.			
	Total nutrients.	Digestible nutrients.	Fuel value.		Total nutrients.	Digestible nutrients.	Fuel value.	
			Calories (Kellner).	Calories (Rübner).			Calories (Kellner).	Calories (Rübner).
Oats	13.76	10.73	19,958	23,820	4.33	3.59	15,150	13,570
Emmer	13.28	9.96	18,525	22,110	1.91	1.36	5,740	5,141
Einkorn	14.67	11.00	20,460	24,420	2.19	1.55	6,542	5,860
Wheat	14.20	11.93	22,190	26,490	2.36	1.49	6,288	5,632
Rye	13.44	11.29	21,000	25,060	1.83	1.17	4,938	4,423
Barley	13.39	9.37	17,428	20,800	1.89	1.66	7,005	6,275
Proso	12.77	6.28	11,680	13,940	3.27	2.51	10,592	9,488
Sorghum	11.71	7.61	14,154	16,890	3.25	2.27	9,580	8,581
Maize	9.91	7.14	13,280	15,850	4.40	3.92	16,542	14,820

Grain.	Crude fiber.				Carbohydrate.				Total fuel value.	
	Total nutrients.	Digestible nutrients.	Fuel value.		Total nutrients.	Digestible nutrients.	Fuel value.		Calories (Kellner).	Calories (Rübner.)
			Calories (Kellner).	Calories (Rübner).			Calories (Kellner).	Calories (Rübner).		
Oats	12.20	3.17	5,896	5,421	66.29	51.04	94,940	87,280	135,944	130,091
Emmer	11.31	4.98	9,263	8,516	69.42	52.06	96,830	89,020	130,358	124,787
Einkorn	13.55	5.96	11,085	10,190	64.02	48.04	89,320	82,150	127,407	122,620
Wheat	2.78	1.30	2,418	2,223	78.72	72.42	134,690	123,840	165,586	158,185
Rye	2.30	1.22	2,269	2,086	80.24	73.82	137,320	126,230	165,527	157,799
Barley	5.64	1.86	3,460	3,181	76.05	69.96	130,120	119,630	158,013	149,886
Proso	8.95	6.11	11,364	10,450	71.23	60.69	112,880	103,780	146,516	137,658
Sorghum	1.80	0.92	1,711	1,573	81.58	74.24	138,080	126,950	163,525	153,994
Maize	2.21	1.28	2,380	2,190	81.96	77.86	144,820	133,140	177,022	166,000

As before stated, the metabolizable energy of a food is the total amount of energy which an animal is able to derive from that portion of food that is digested and actually used by it after allowing for all waste. This was originally termed the available energy of the food and was considered to be a measure of the value of the food. There are, however, still other factors entering into the problem that need to be considered which make it necessary to distinguish between this available or metabolizable energy and the net available energy of the food.

The animal body has been likened by Armsby to a steam boiler fed by means of a mechanical stoker, the power for operating which comes from the steam generated in the boiler itself. The available energy of the coal for producing steam power is equivalent to the fuel value of the coal less that of the refuse and again diminished by the amount of energy used in operating the mechanical stoker. Similar conditions obtain in the animal body. In order to get the food and chew and digest it, a certain amount of the animal energy must be used, and the real available energy of the food is therefore equivalent to the metabolizable energy, or gross available energy, less the energy expended during the eating and digestion.

PRODUCTION VALUE.

The finally available energy of the food may be of value in two ways, depending on the object for which the animal is fed. It may be desired simply to prevent the loss of flesh or energy, i. e., the object may be to maintain the animal in all respects in a certain desirable condition. Food given for such a purpose is known as a "maintenance ration," and each of the nutrients has a value as a part of such a ration, which value can only be determined by experiments on animals, for it has been found that the metabolizable energy and the energy as maintenance are not equal. This work has been done by Armsby,[a] who found in general that 62.92 per cent of the metabolizable energy of clover hay was available for maintenance.

On the other hand, a ration may be fed to animals for the purpose of producing increase in flesh, and consequently more than a maintenance ration must be given. In this case, that part of the food that is in excess of what is required for maintenance is used by the animal for increase in flesh and has a definite value as such. In experiments to determine the value of a given food for producing flesh, the material is fed in addition to a basal maintenance ration and its value determined as measured by the gain in flesh produced. The value so found has been termed the *production value* of the food. Kellner[b] has determined these production values for the pure nutrients when fed in addition to a basal maintenance ration to mature fattening cattle. He found that while the ratio of the nutrients to each other remained nearly the same the actual values for production are only about one-half the metabolizable values.

TABLE VI.—*Comparison of metabolizable energy and production value of nutrients per pound.*

Nutrient.	Metabolizable energy.	Production value.
	Calories.	*Calories.*
Protein	2,220	1,016
Ether extract	3,780	2,273
Carbohydrates	1,710	1,071

The most direct and the simplest method of expressing this production value is in Calories per pound or per 100 pounds, as is done by Armsby[c] in recent publications of the Pennsylvania agricultural experiment station in cooperation with the Bureau of Animal Industry of the Department of Agriculture. In Kellner's work, however, the values are expressed in different terms. It has been found[a] that the production values in Calories for the various nutrients correspond to the production of a definite weight of body tissue, chiefly fat. The figures so obtained are as follows:

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[a] Pennsylvania Agr. Exp. Sta. (1905), Bul. 71, p. 12.

[b] Loc. cit., p. 153.

[c] Loc. cit.

Table VII.—*Production value of nutrients of foods.*

Nutrient.	Production value.	
	Calories per pound.	Pounds flesh gained per 100 pounds nutrient.
Protein	1,016	23.5
Ether extract:		
Coarse fodders	2,041	47.4
Grains	2,273	52.6
Concentrated foods	2,585	59.8
Starch and crude fiber	1,071	24.8
Sugar	812	18.8

If one of these nutrients be selected as a standard and its value, stated in Calories or in pounds flesh gained, be regarded as unity, the total production value may also be expressed in terms of this unit. Starch is the nutrient that has been taken as unity in this case, and its value of 1,071 Calories per pound, or 24.8 pounds of fat gained per hundred pounds, is the unit of measurement. The value of each nutrient in pounds of starch is calculated, and from this the total value of the food in pounds of starch, equivalent to 100 pounds of the food, is obtained. This is termed the starch value (or "Stärkewert").

There are, then, three terms in which the production value of a food may be expressed: (1) Calories per 100 pounds; (2) pounds of flesh gained per 100 pounds; (3) starch value per 100 pounds. These three methods of expresssion are illustrated and shown comparatively in Table VIII, giving the digestible nutrients and the individual and total production values in terms of each unit described.

Table VIII.—*Production value of various foods expressed according to three methods.*

[Pounds per hundred pounds of dry matter.]

Grain.	Protein.				Ether extract.			
	Digestible.	Production value.			Digestible.	Production value.		
		Calories.	Flesh gained.	Starch value.		Calories.	Flesh gained.	Starch value.
Oats	10.73	10,893	2.52	10.2	3.59	8,171	1.89	7.6
Emmer	9.96	10,127	2.34	9.4	1.36	3,068	.71	2.9
Einkorn	11.00	11,153	2.58	10.4	1.55	3,502	.81	3.3
Wheat	11.93	12,233	2.83	11.4	1.49	3,372	.78	3.1
Rye	11.29	11,457	2.65	10.7	1.17	2,637	.61	2.5
Barley	9.37	9,511	2.20	8.9	1.66	3,761	.87	3.5
Proso	6.28	6,398	1.48	6.0	2.51	5,706	1.32	5.3
Sorghum	7.61	7,738	1.79	7.2	2.27	5,144	1.19	4.8
Maize	7.14	7,263	1.68	6.8	3.92	8,906	2.06	8.3

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[a] Kellner, loc. cit., pp. 153, 379.

TABLE VIII.—*Production value of various foods expressed according to three methods*—Con.

Grain.	Crude fiber.				Carbohydrates.				Total production value.		
	Digestible.	Production value.			Digestible.	Production value.					
		Calories.	Flesh gained.	Starch value.		Calories.	Flesh gained.	Starch value.	Calories.	Flesh gained.	Starch value.
Oats	3.17	3,415	0.79	3.2	51.04	54,730	12.66	51.0	77,209	17.86	72.0
Emmer	4.98	5,360	1.24	5.0	52.06	55,810	12.91	52.1	74,356	17.20	69.4
Einkorn	5.96	6,398	1.48	6.0	48.04	51,620	11.94	48.1	72,673	16.81	67.8
Wheat	1.30	1,383	.32	1.3	72.42	77,642	17.96	72.4	94,500	21.86	88.1
Rye	1.22	1,297	.30	1.2	73.82	71,958	18.31	73.8	94,544	21.87	88.2
Barley	1.86	1,989	.46	1.8	69.96	75,005	17.35	70.0	90,264	20.88	84.2
Proso	6.11	6,571	1.52	6.1	60.69	65,062	15.05	60.7	83,736	19.37	78.1
Sorghum	.92	9,943	.23	.9	74.24	79,590	18.41	74.2	93,463	21.62	87.2
Maize	1.28	1,383	.32	1.3	77.86	83,480	19.31	77.9	100,985	23.36	94.2

The advantage in expressing the production values in Calories per hundred pounds is that the results are easily comparable, whether the object of feeding is the production of flesh, as with fattening cattle, or the production of muscular energy, as with work horses. The disadvantage is that the unit is so small that the number expressing the final value is too large to convey a distinct idea concerning it. Numbers of five and six figures are difficult to grasp readily, and though differences are at the same time magnified the real meaning of the results is harder to comprehend with large numbers than with smaller ones. It is also true that to the average mind not trained in scientific thought the term "Calories per hundred pounds" is much more vague than either "pounds of flesh" gained or even the "starch value." The last, while expressed in numbers which are as easily compared as those expressing pounds of flesh gained, is not quite so commonly understood and, though readily transferable for either flesh or energy production, it has been set aside, the preference being given to the expression "pounds of flesh gained per hundred pounds of food." This term is readily understood by all who feed stock and is definite and applicable in the majority of cases.[a]

On account of these facts, the production values for each nutrient and for the whole food have been calculated and expressed in this investigation in terms of "pounds of flesh gained per hundred pounds of food." Attention must be called to the fact that this term does not mean exactly pounds of live weight gained, for the latter includes with the gain in the flesh or fat the increase in water also and will therefore always be somewhat higher. However, while not exactly synonymous, the two terms are approximately the same and express the increase in flesh or weight as the result of feeding 100 pounds of food in addition to a basal maintenance ration.

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[a] Since the above was written, Armsby (Science, 1907, *26:* 670) has proposed a new unit for the energy value of rations, namely, the "Therm=T," equivalent to 1,000 large Calories, or 1,000,000 gram calories.

COMPARATIVE NUTRITIVE VALUE AND NUTRITIVE RATIO.

According to the figures given by Rübner for the metabolizable energy of the nutrients of food, protein and starch have an equal value, namely, 1,860 Calories, while the ether extract has 2.25 times as much, namely, 4,220 Calories. This relation has led to the use of two factors for valuation based directly on the amount of digestible nutrients present. If the amount of ether extract is multiplied by 2.25 it is then measured on the same scale as the other nutrients and the sum of the amounts of all the nutrients is therefore directly comparable, one food with another. The total amount of nutrients so found is known as the comparative nutritive value; that is, comparative nutritive value = protein + carbohydrate + (ether extract × 2.25). The figures thus obtained express the relative value of foods measured by the amount of digestible nutrients present.

Another factor based on these facts is the nutritive ratio which expresses the relative amounts, in a food, of the two classes of nutrients, namely, the heat-producing nutrients and those producing flesh or tissue. The proteins of a food are the constituents which build up the tissue of the animal and are productive of muscular energy. The carbohydrates and fats, on the other hand, are chiefly heat or fat producers. The ratio between these two groups has been long considered as of value in indicating the general character of the food as fattening and heat producing or as productive of increased muscular tissue and energy.

This ratio, "protein : (carbohydrates + ether extract × 2.25) :: 1 : x," is termed "broad" when it is :: 1 : 8–12 as in maize and indicates a predominance of heating or fattening elements; and it is termed "narrow" when it is :: 1 : 4–7, as in oats, in which the constituents producing muscular tissue are in excess. The comparative nutritive value and the nutritive ratio of these grains, which have been discussed in the preceding tables, are shown in Table IX.

Table IX.—*Comparative nutritive value and nutritive ratio of grains.*

Grain.	Comparative nutritive value.	Nutritive ratio.	Grain.	Comparative nutritive value.	Nutritive ratio.
Oats	73.01	5.8	Barley	84.92	8.0
Emmer	70.06	6.0	Proso	78.73	11.5
Einkorn	68.49	5.2	Sorghum	87.88	10.5
Wheat	89.00	6.5	Maize	95.10	12.3
Rye	88.96	6.9			

Table IX shows clearly the significance of the term "nutritive ratio" as exemplified by the two characteristically different grains maize and oats, the former being a heat-producing food with a ratio 1 : 12.3, and the latter a tissue-forming food whose ratio is 1 : 5.8.

PLAN OF THE PRESENT INVESTIGATION.

METHOD OF ESTIMATING THE RELATIVE FOOD VALUES OF GRAINS.

While the direct experimental method is without question the one on which to rely for the determination of the maintenance or production values of feeding stuffs, it is not always possible to make such investigations on living animals with a large number of foods. Such direct experiments have been made both in this country and Europe by the investigators previously mentioned, and their work embraces quite a number of different animals and foods. Taking the results of these investigations as a basis, and using the factors that have thus been found to apply to certain animals and certain foods, it is possible to calculate from simple analytical data the production values of a larger number of samples of feeding stuffs than could possibly be determined in any other way. The production values and nutritive ratios of foods thus determined form the best basis now available for a comparative or even for an actual valuation of stock foods.

In the present investigation of the feeding value of cereal grains this method has been used to determine the relative value of the different grains studied. It is not claimed that these results are as accurate as those that would have been obtained had careful feeding experiments been made with each sample, but as the factors used in calculating the final values are based upon average results with each group or class of grain studied, the calculated values are the best obtainable from simple analytical results. Neither total fuel value, total metabolizable energy, nor comparative nutritive value have been calculated, because with grains, where the chief object in feeding is the production of flesh, the production value and nutritive ratio express the values best. As stated previously, the factors used are those given by Kellner, except in the case of sorghum, to which material the recent results of Tangl are more applicable. For coefficients of digestibility as given in Table II (p. 9), figures for the identical species of cereal were used when this was known without question, as with oats, barley, rye, wheat, and maize. For emmer and einkorn the figures are those for the German "Spelzweizen," which is identical with one, but not with the other. The two grains are, however, so similar that little error is probably introduced. For nonsaccharine sorghums, the figures are those for "Dari," and for proso, Tangl's figures for "Besenhirsekorn," fed to oxen. For production values the factors of Kellner given in Tables VI and VII (pp. 13 and 14) are used.

DESCRIPTION OF MATERIAL EXAMINED.

The material examined in the present investigation consists of samples of different grains that have been under field trial by the Office of Grain Investigations of the Bureau of Plant Industry during the last few years. The following cereal grains are represented: Oats, emmer, einkorn, wheat, rye, barley, proso, sorghum, and maize. Under each class the samples consist, when possible, of both the original imported seed and grain grown from this seed in various sections of the United States.

The greater part of the work on the introduction of new cereal grains has had to do with the semiarid regions of this country, the cereals introduced having been selected either on account of (1) drought-resistant qualities, or (2) rust or disease resistance, in addition to their yield and general character. Whether or not these qualities are maintained on introduction into this country can only be determined by field tests, moreover, two questions arise in regard to these introduced grains: (1) Are they of equal or superior quality to domestic varieties, and (2) do they maintain their characteristic properties and qualities when grown for successive years in the United States.

The analyses made in this investigation and their correlation for the relative valuation of the samples studied are an attempt to answer these questions without entering into a study of the direct effect of change of environment on the properties of cereals.

DISCUSSION OF RESULTS.

The complete tabular results of all analyses with the calculated production values for each nutrient and for the whole food are given in the tables at the close of the bulletin (p. 48). The discussion of tables of average results are presented in the following pages, each cereal being discussed under a separate caption.

Oats (*Avena sativa*).

COMPARISON OF DOMESTIC AND FOREIGN OATS.

The present investigation was undertaken primarily to study the properties and composition of the Swedish Select oat, a very desirable variety, the seed of which was introduced from Russia in 1899 by the Office of Grain Investigations, U. S. Department of Agriculture. This oat is especially resistant to drought and rust, is strong and hardy, and makes a good yield. It answers, therefore, particularly well all the requirements for introduction.

Among the oats analyzed there are 128 samples of the Swedish Select oat grown in various sections of the United States. In addition to these, there are 89 samples from 13 varieties of introduced oats which have been grown in the United States for a short time, usually not more than three years. There are also 25 samples, representing 10 varieties of purely domestic oats. This makes 242 samples, representing 24 varieties of oats grown in the United States either from purely domestic seed or from recently introduced foreign seed. For comparison with these analyses, 54 samples, representing 37 varieties of strictly foreign-grown oats, were analyzed, including most of the varieties represented in the two classes of introduced oats just mentioned.

This selection of samples makes it possible to compare domestic and foreign grown oats in general, as well as samples of the same variety grown in Europe and in this country and different varieties of introduced grain that have been grown in the United States for several years.

The composition of a typical domestic oat, expressed both as total and digestible nutrients, has been given as follows:[a]

TABLE X.—*Typical United States oats.*

[Recalculated to dry basis per hundred pounds.]

Nutrient.	Total.	Digestible.
	Pounds.	*Pounds.*
Moisture	10.00	....
Protein	13.33	10.40
Fat	5.00	4.15
Crude fiber	13.33	3.46
Carbohydrate	64.44	49.62

The mean of 72 samples of United States and Canadian oats analyzed at the Columbian Exposition in Chicago in 1893 is given in Table XI.[b]

TABLE XI.—*United States and Canadian oats, 1893.*

[Recalculated to dry basis per hundred pounds.]

Nutrient.	Total.	Digestible.
	Pounds.	*Pounds.*
Moisture	9.96	....
Protein	13.40	10.45
Fat	4.91	4.07
Crude fiber	13.24	3.44
Carbohydrate	64.73	49.84

The mean of 25 samples of purely domestic oats studied in this investigation has been found to be as follows:

TABLE XII.—*United States oats, 1906.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	Pounds.	*Pounds.*
Moisture	8.20	....
Protein	13.60	10.60
Fat	5.62	4.67
Crude fiber	11.46	2.98
Carbohydrate	65.18	50.19

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[a] U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1180.

[b] U. S. Dept. Agr., Bureau of Chemistry, 1895, Bul. 45, p. 29.

The 128 samples of Swedish Select oats grown in the United States were found to have a mean composition as follows:

TABLE XIII.—*Swedish Select oats.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	Pounds.	*Pounds.*
Moisture	7.10	....
Protein	12.85	10.02
Fat	4.00	3.32
Crude fiber	12.23	3.18
Carbohydrate	66.99	51.58

The mean of 242 samples of recently introduced miscellaneous varieties grown in the United States was found to be as follows:

TABLE XIV.—*Miscellaneous introduced varieties of oats.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	Pounds.	*Pounds.*
Moisture	7.82	....
Protein	13.76	10.73
Fat	4.33	3.59
Crude fiber	12.20	3.17
Carbohydrate	66.29	51.04

Fifty-four samples of foreign-grown oats, including most of the varieties represented in Table XIV, were found to have the mean composition shown in Table XV.

TABLE XV.—*Foreign oats.*

[Per hundred pounds of dry matter.]

Nutrient.	Total.	Digestible.
	Pounds.	*Pounds.*
Moisture	8.31	....
Protein	11.63	9.07
Fat	5.86	4.86
Crude fiber	10.89	2.83
Carbohydrate	67.91	52.28

Table XVI gives the digestible nutrients, the total production values, and the nutritive ratios of these representative groups, together with a few analyses obtained from other sources, the last named being calculated from the original analyses reported in the places cited.

TABLE XVI.—*Group values for digestible nutrients, production value, and nutritive ratio of oats, domestic and foreign.*

[Pounds per hundred pounds of dry matter.]

Description of grain.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrate.	Calories.	Gain in flesh.	
Typical United States, 1898 [a]	....	10.40	4.15	3.46	49.62	77,395	17.88	6.0
Mean, United States and Canada, 1893 [b]	72	10.45	4.07	3.44	49.84	77,049	17.80	6.0
Miscellaneous, United States, 1906	242	10.73	3.59	3.17	51.04	77,209	17.86	5.8
Strictly United States, 1906	25	10.60	4.67	2.98	50.19	78,377	18.11	6.0
Swedish Select, United States, 1906	128	10.02	3.32	3.18	51.58	76,431	17.68	6.2
Miscellaneous European, 1906	54	9.07	4.86	2.83	52.28	79,327	18.35	7.3
Foreign [c]	....	9.26	4.59	3.09	51.69	78,510	18.17	7.0
Foreign [d]	307	9.07	5.02	2.93	51.57	79,024	18.28	7.2

[a] U. S. Department of Agriculture, Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1180.
[b] U. S. Department of Agriculture, Bureau of Chemistry, 1895, Bul. 45, p. 29.
[c] Kellner, loc. cit., p. 561, recalculated to dry basis.
[d] König, Chemie der menschlichen Nahrungs- und Genussmittel, 1903, p. 533, recalculated to dry basis.

It will be seen from these data that there is a distinct difference between the foreign-grown oats and those grown in the United States. The foreign-grown oats, such as the miscellaneous samples reported by König, the standard used by Kellner, and the 54 samples of foreign-grown oats analyzed in the present investigation, show these differences plainly. This variation in composition may be stated as follows: Oats grown in the United States are characterized, as a rule, by higher protein, lower carbohydrate, lower fat, and higher crude fiber. These differences in composition affect the production value and the nutritive ratio, often making the former lower in the oats grown in the United States and the latter narrower. The differences in the production values are not great, however; the maximum difference in pounds of flesh gained between the domestic-grown Swedish Select oat (17.68 pounds) and the miscellaneous foreign oats analyzed in this bulletin (18.35 pounds) being only 0.67 pound, while the minimum difference between the highest domestic oat and the lowest foreign oat was only 0.06 pound of flesh gained per hundred pounds of oats fed. The results obtained in the present study afford a direct comparison of the foreign oat and the same oat grown in the United States, since in most cases the domestic-grown oat was obtained from the same seed as the sample from which the analysis of the foreign oat was made.

TABLE XVII.—*Comparison of domestic and foreign grown oats of the same varieties.*

[Per hundred pounds of dry matter.]

Variety.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrate.	Calories.	Gain in flesh.	
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*		*Lbs.*	
Swedish Select:								
Foreign	3	9.89	3.62	2.98	52.89	78,160	18.08	6.5
United States	128	10.02	3.32	3.18	51.58	76,431	17.68	6.2
Belgian Winter:								
Foreign	4	8.76	5.66	2.28	54.00	82,115	18.99	7.9
United States	4	8.82	4.38	3.56	49.97	76,258	17.64	7.2
Tobolsk:								
Foreign	2	9.68	5.06	3.35	50.68	79,262	18.33	6.8
United States	9	10.12	4.08	3.49	50.30	77,252	17.87	6.2
North Finnish Black:								
Foreign	3	8.19	4.54	2.75	51.37	78,949	18.26	6.3
United States	12	9.44	4.06	3.44	50.56	76,733	17.75	[b] 6.7
Shatilov:								
Foreign	1	9.41	4.81	3.47	49.93	77,727	17.98	6.8
United States	1	[a] 9.19	3.43	5.00	46.57	72,410	16.75	6.4
Red Algerian:								
Foreign	1	8.24	4.98	2.75	52.70	79,154	18.31	8.1
United States	10	10.29	4.32	3.18	49.75	77,036	17.82	6.1
United States	164	+	−	+	−	−	−	−
Foreign	14	−	+	−	+	+	+	+

[a] The United States grown Shatilov has less protein than the foreign.
[b] The United States grown North Finnish Black has a broader nutritive ratio than the foreign.

In considering this table it will be noticed that while in most cases the number of domestic samples was considerably larger than the number of foreign and in two cases only one sample each was analyzed, still the comparison is even more striking than in the preceding table. The general statement that the domestic oats contain more protein and crude fiber and less fat and carbohydrate with a lower total production value and a narrower nutritive ratio is upheld by the results in this table with two exceptions. Of the variety Shatilov, only one sample each of domestic and foreign origin having been analyzed, the domestic grain fell below the foreign grown in protein content though it showed the characteristic composition in all other points. The North Finnish Black domestic-grown oat showed the characteristic distinction from the foreign grown in all the nutritive constituents and in the production value, but in the nutritive ratio it differed by being broader, not narrower, than the foreign-grown grain.

These characteristic differences, as shown by average results, are exemplified in a striking way by some individual cases, though, of course, there are also some marked exceptions. The group averages for protein content of domestic and foreign oats show a higher protein content for the domestic samples (Table XVIII, p. 24), and the complete table of individual data (Table XXXVIII, p. 48) shows that of the 54 foreign-grown samples there is only one that has a protein content above the average of the domestic grain. This is No. 1224, North Finnish Black grown in Finland, with digestible protein per hundred pounds amounting to 12.33 pounds, the average of all United

States samples being 10.73 pounds. Of the 242 domestic samples there are only 58 which fell below the average (9.07 pounds) of foreign-grown oats in protein content, and furthermore there is only one sample out of the 54 foreign-grown oats which has a nutritive ratio as narrow or narrower than the average of the United States samples, namely 5.8. This is the same sample, No. 1224, with a nutritive ratio of 5.1. There are only 39 of the 242 domestic samples which have a nutritive ratio as broad or broader than the average (7.3) of the foreign. Three foreign samples show a production value as low, or lower, than the average United States grain, while there are 18 samples of the United States oats that have a production value as high or higher than the maximum foreign grown.

Of the United States samples the variety which gave the highest average protein content is the Sixty Day oat, 39 samples of which had an average digestible protein content of 11.46 pounds. The highest individual samples were two samples of Sixty Day oat, one grown in Ohio, No. 1297, with 15.40 pounds digestible protein, and the other in South Dakota, No. 1274, with 15.12 pounds. These three instances were also the ones showing the narrowest nutritive ratios, which were, respectively, 5.3, 3.7, and 3.9. The lowest average protein content of the United States grain was found in four samples of Belgian Winter, which gave 8.82 pounds of digestible protein, being 0.25 pound lower than the average foreign oats and only 0.06 pound higher than the four corresponding samples of Belgian Winter grown in Europe. The nutritive ratio of these domestic Belgian Winter samples was the broadest of all of the United States oats, namely, 7.2, only 0.1 lower than the foreign average.

Thus it is evident that the characteristic tendency of the oats grown in the United States, when compared with oats grown in Europe, is toward a higher protein content with a correspondingly lower amount of carbohydrate, resulting in a narrow nutritive ratio combined with a slightly lower production value.

In comparison with the other cereals, oats belong to the energy or muscle-producing grains with high protein and narrow nutritive ratio as contrasted with the fat or heat-producing grains, such as maize, which possess a smaller amount of protein and a broad nutritive ratio. As shown by Tables XVI and XVII, the oats grown in the United States appear to be less inclined toward the maize type and to have their oat characteristics more strongly emphasized than do the same or similar varieties grown in Europe.

TABLE XVIII.—*Oats analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N × 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
						Total.	Digestible.	Production value. (Gain in flesh.)	Total.	Digestible.	Production value. (Gain in flesh.)	Total.	Digestible.	Production value. (Gain in flesh.)	Total.	Digestible.	Production value. (Gain in flesh.)	Gain in flesh.	Calories.	
54	Miscellaneous	Foreign	8. 31	91. 69	3. 61	11. 63	9. 07	2. 13	5. 86	4. 86	2. 56	10. 89	2. 83	0. 70	67. 91	52. 28	12. 96	18. 35	79,327	7. 3
2	Hull-less	.....do	8. 04	91. 96	2. 51	18. 37	14. 33	3. 37	6. 26	5. 20	2. 74	2. 80	. 73	. 18	70. 05	53. 94	13. 37	19. 66	84,900	4. 6
128	Swedish Select	United States	7. 10	92. 90	3. 90	12. 85	10. 02	2. 35	4. 00	3. 32	1. 75	12. 23	3. 18	. 79	66. 99	51. 58	12. 79	17. 68	76,431	6. 2
39	Sixty Day	.....do	8. 90	91. 10	3. 94	14. 69	11. 46	2. 69	3. 89	3. 23	1. 70	11. 00	2. 86	. 71	66. 55	51. 24	12. 71	17. 81	76,993	5. 3
9	Tobolsk	.....do	8. 53	91. 47	3. 37	12. 97	10. 12	2. 38	4. 91	4. 08	2. 15	13. 43	3. 49	. 87	65. 32	50. 30	12. 47	17. 87	77,252	6. 2
2	Shatilov	.....do	8. 99	91. 01	4. 39	11. 78	9. 19	2. 16	4. 13	3. 43	1. 80	19. 25	5. 00	1. 24	60. 44	46. 57	11. 55	16. 75	72,410	6. 4
4	Belgian winter	.....do	8. 18	91. 82	4. 80	11. 31	8. 82	2. 07	5. 28	4. 38	2. 30	13. 69	3. 56	. 88	64. 90	49. 97	12. 39	17. 64	76,258	7. 2
12	North Finnish black	.....do	8. 76	91. 24	4. 00	12. 10	9. 44	2. 22	4. 89	4. 06	2. 14	13. 32	3. 44	. 85	65. 67	50. 56	12. 54	17. 75	76,733	6. 7
3	Crown red	.....do	8. 72	91. 28	4. 64	13. 25	10. 34	2. 43	4. 33	3. 59	1. 89	15. 81	4. 11	1. 02	61. 97	47. 71	11. 83	17. 17	74,226	5. 8
8	Rust proof	.....do	7. 74	92. 26	3. 75	13. 32	10. 39	2. 44	4. 61	3. 83	2. 01	11. 60	3. 02	. 75	65. 72	50. 60	12. 55	17. 75	76,733	6. 0
5	Culberson winter	.....do	8. 74	91. 26	3. 56	12. 74	9. 94	2. 34	6. 21	5. 15	2. 71	11. 73	3. 05	. 76	65. 76	50. 62	12. 55	18. 36	79,370	6. 6
10	Red Algerian	.....do	8. 61	91. 39	4. 74	13. 19	10. 29	2. 42	5. 20	4. 32	2. 27	12. 25	3. 18	. 79	64. 62	49. 75	12. 34	17. 82	77,036	6. 2
7	Burt	.....do	8. 56	91. 44	4. 37	14. 34	11. 19	2. 63	6. 21	5. 15	2. 71	11. 41	2. 97	. 74	63. 67	49. 02	12. 16	18. 24	78,852	5. 7
2	Snoma	.....do	8. 84	91. 16	3. 42	13. 22	10. 31	2. 42	6. 23	5. 17	2. 72	9. 26	2. 41	. 60	67. 85	52. 24	12. 95	18. 69	80,797	6. 4
13	Miscellaneous	.....do	8. 37	91. 63	4. 06	12. 96	10. 11	2. 38	4. 83	4. 01	2. 16	12. 58	3. 27	. 81	65. 25	50. 24	12. 46	17. 81	76,993	6. 2
242	All U. S. varieties	....do	7. 82	92. 18	3. 96	13. 76	10. 73	2. 52	4. 33	3. 59	1. 89	12. 20	3. 17	. 79	66. 29	51. 04	12. 66	17. 86	77,209	5. 8
25	Purely domestic	....do	8. 20	91. 80	3. 86	13. 60	10. 60	2. 49	5. 62	4. 67	2. 45	11. 46	2. 98	. 74	65. 18	50. 19	12. 44	18. 11	78,289	6. 0
19	Swedish select	Nebraska	6. 63	93. 37	4. 39	12. 66	9. 87	2. 32	3. 74	3. 10	1. 63	14. 22	3. 70	. 92	64. 94	50. 00	12. 40	17. 27	74,658	6. 1
14	.....do	South Dakota	6. 87	93. 13	3. 84	13. 13	10. 24	2. 41	4. 48	3. 72	1. 96	12. 13	3. 15	. 78	66. 42	51. 14	12. 68	17. 83	77,079	6. 1
14	.....do	Iowa	6. 68	93. 32	4. 02	11. 40	8. 89	2. 09	3. 87	3. 21	1. 69	13. 96	3. 63	. 90	66. 80	51. 44	12. 76	17. 44	75,393	7. 0
15	.....do	Michigan	7. 03	92. 97	3. 56	12. 94	10. 09	2. 37	4. 02	3. 34	1. 76	11. 83	3. 08	. 76	67. 65	52. 09	12. 92	17. 81	76,993	6. 2
12	.....do	Wisconsin	6. 67	93. 33	3. 53	11. 49	8. 96	2. 11	4. 11	3. 41	1. 79	12. 35	3. 21	. 80	68. 52	52. 76	13. 08	17. 78	76,863	7. 1
6	.....do	Montana	6. 63	93. 37	4. 09	13. 63	10. 63	2. 50	4. 09	3. 39	2. 05	9. 59	2. 49	. 62	68. 00	52. 36	12. 98	18. 15	78,463	6. 0
6	.....do	Kansas	6. 90	93. 10	4. 42	14. 46	11. 28	2. 65	3. 95	3. 23	1. 73	12. 12	3. 15	. 78	64. 92	49. 99	12. 40	17. 56	75,912	5. 4
5	.....do	Washington	7. 40	92. 60	3. 78	12. 66	9. 87	2. 32	4. 45	3. 69	1. 94	10. 09	2. 62	. 65	69. 01	53. 14	13. 18	18. 09	78,203	6. 5
5	.....do	New York	7. 29	92. 71	3. 39	13. 01	10. 15	2. 39	3. 54	2. 94	1. 55	11. 03	2. 88	. 71	68. 98	53. 11	13. 17	17. 82	77,036	6. 2
4	.....do	Illinois	7. 08	92. 92	3. 78	14. 44	11. 26	2. 65	3. 33	2. 76	1. 45	11. 79	3. 07	. 76	66. 66	51. 33	12. 73	17. 59	76,041	5. 4
4	.....do	Pennsylvania	7. 86	92. 14	3. 19	13. 58	10. 59	2. 49	4. 15	3. 44	1. 81	11. 31	2. 94	. 73	67. 77	52. 18	12. 94	17. 97	77,684	5. 9
4	.....do	Colorado	8. 33	91. 67	4. 46	14. 74	11. 50	2. 70	3. 79	3. 15	1. 66	11. 14	2. 90	. 71	65. 87	50. 72	12. 58	17. 66	76,344	5. 3
3	.....do	North Carolina	7. 11	92. 89	4. 03	12. 63	9. 85	2. 31	3. 41	2. 83	1. 49	12. 99	3. 38	. 84	66. 94	51. 54	12. 78	17. 42	75,307	6. 2

3	.....do	Indiana	7.92	92.08	3.56	13.42	10.47	2.46	3.16	2.62	1.38	11.57	3.01	.75	68.19	52.50	13.02	17.61	76,128	5.9
3	.....do	Idaho	7.76	92.24	4.57	11.83	9.23	2.17	4.61	3.83	2.01	9.92	2.58	.64	69.06	53.17	13.18	18.00	77,814	7.0
2	.....do	Texas	7.58	92.42	4.15	14.87	11.60	2.73	3.32	2.75	1.45	11.91	3.10	.77	65.73	50.61	12.55	17.50	75,652	5.2
2	.....do	Missouri	8.79	91.21	4.47	11.81	9.21	2.16	2.66	2.21	1.16	15.84	4.12	1.02	62.41	48.05	11.92	16.26	70,292	6.2
2	.....do	North Dakota	9.47	90.53	3.57	12.47	9.73	2.29	5.05	4.19	2.20	9.84	2.56	.63	69.56	53.56	13.28	18.40	79,543	6.7
2	.....do	Canada	7.21	92.79	3.34	13.78	10.75	2.53	4.24	3.52	1.85	10.85	2.69	.67	68.28	52.57	13.04	18.09	78,203	5.9
3	.....do	Miscellaneous	8.50	91.50	3.21	13.79	10.76	2.53	4.04	3.35	1.76	10.66	2.77	.69	68.31	52.60	13.05	18.03	77,944	5.8
128	.....do	All United States	7.10	92.90	3.90	12.85	10.02	2.35	4.00	3.32	1.75	12.23	3.18	.79	66.99	51.58	12.79	17.68	76,430	6.2
14	Sixty Day	South Dakota	9.05	90.95	3.74	14.96	11.67	2.74	4.25	3.53	1.86	10.71	2.78	.69	66.33	51.07	12.66	17.95	77,598	5.3
4	.....do	North Dakota	8.38	91.62	4.09	14.78	11.53	2.71	4.25	3.53	1.86	10.10	2.63	.65	66.77	51.41	12.75	17.97	77,684	5.4
21	.....do	Miscellaneous	8.90	91.10	4.03	14.50	11.31	2.66	3.59	2.98	1.57	11.37	2.96	.73	66.65	51.32	12.73	17.69	76,473	5.4
39	.....do	All United States	8.90	91.10	3.94	14.69	11.46	2.69	3.89	3.23	1.70	11.00	2.86	.71	66.55	51.24	12.71	17.81	76,993	5.3
7	Tobolsk	South Dakota	8.44	91.56	3.32	12.44	9.70	2.23	4.96	4.12	2.17	13.89	3.61	.89	65.39	50.35	12.48	17.82	77,036	6.5
2	.....do	Miscellaneous	9.34	90.66	3.54	14.84	11.57	2.72	4.72	3.92	2.06	11.84	3.08	.76	65.05	50.08	12.42	17.96	77,641	5.3
9	.....do	All United States	8.53	91.47	3.37	12.97	10.12	2.38	4.91	4.08	2.15	13.43	3.49	.87	65.32	50.29	12.47	17.87	77,252	6.2
5	North Finnish black	South Dakota	9.33	90.67	4.03	11.66	9.09	2.14	3.81	3.16	1.66	15.74	4.09	1.01	64.75	49.85	12.36	17.17	74,226	6.7
7	.....do	Miscellaneous	8.35	91.65	3.98	12.42	9.69	2.28	5.67	4.71	2.48	11.59	3.01	.75	66.33	51.08	12.67	18.18	78,592	6.7
12	.....do	All United States	8.76	91.24	4.00	12.10	9.44	2.22	4.89	4.06	2.14	13.32	3.46	.86	65.67	50.56	12.54	17.76	76,777	6.7
2	Red Algerian	South Dakota	8.98	91.02	4.31	12.78	9.97	2.34	4.95	4.11	2.16	12.99	3.38	.84	64.98	50.05	12.41	17.75	76,712	6.3
8	.....do	Miscellaneous	8.51	91.49	4.85	13.29	10.36	2.44	5.26	4.37	2.30	12.07	3.14	.78	64.53	49.69	12.32	17.84	77,101	6.2
10	.....do	All United States	8.61	91.39	4.74	13.19	10.29	2.42	5.20	4.32	2.27	12.25	3.18	.79	64.62	49.75	12.34	17.82	77,036	6.2

PRODUCTIVE VALUE AND NUTRITIVE RATIO AS A BASIS FOR EXACT VALUATION.

From a study of the data presented in these or similar tables of analysis of feeding stuffs, it is seen that by considering simply differences in the amounts of the four nutritive constituents a very indefinite conclusion is often reached. If two distinctly different cereals are considered, such as oats and corn, the differences in the amounts of the nutritive constituents are considerable, as would be expected. When, however, we have to deal with cereals that are very similar, such as rye and wheat, or with simply different samples or varieties of the same cereal, the differences in the amounts of the nutritive constituents are so small and so nearly counterbalance each other that it is impossible to form any opinion as to their relative value based on these factors alone. It is, therefore, necessary to secure some factor that either sums up or magnifies the slight differences in composition if a true valuation of similar feeding stuffs is to be made. Even with such a factor it is natural that differences should not be great between different samples or different varieties of the same cereal. The most distinctly different foreign and domestic oat, for example, can not show wider differences in composition than are possible between plants belonging to the same species.

Various efforts have been made to obtain such a factor, and it has seemed to the writer that the best comparison and relative valuation of similar or slightly different samples of feeding materials is secured by a consideration of the *production value*, and especially when this is considered in connection with the *nutritive ratio*. The production value gives, in the most accurate terms known, the amount of energy (expressed either in calories, weight of flesh gained, or in any other unit), which a definite amount of a certain food will produce when fed as a production ration in addition to a basal maintenance ration. The nutritive ratio gives the relation between the protein and other nutrient constituents of a food, i. e., between the constituents essential in producing muscular energy and those essential in producing fat and heat. As the uses of various foods are different, one class for producing muscular energy or work and the other class for increasing flesh or maintaining animal heat, so the value of a food will depend upon the use for which it is intended, and it is not possible to use any factor for the valuation of foods without considering this point.

Cereal grains, as a class, are naturally much alike in their general composition, but may be divided into two subclasses or groups, the one typified by oats or wheat, high in protein, relatively low in carbohydrate, with a narrow nutritive ratio, and the other, typified by maize, being the opposite of the first, low (relatively) in protein, rich in carbohydrate, and with a broad nutritive ratio.

With these two typical grains as examples we may judge of the tendency of a variety or sample, under certain observed conditions of growth, etc., to partake of the properties of one or the other of these extremes and in the case of these two cereals themselves to observe whether a variety or sample shows by its composition a more strongly typified individual of its class or whether it is less typical and inclined toward the other class.

TABLE XIX.—*Comparison of oats and maize as typical energy-producing and fat-producing cereals.*

[Pounds per hundred pounds of dry matter.]

Grain.	Digestible nutrients.				Production value.		Nutritive ratio.
	Protein.	Fat.	Crude fiber.	Carbohydrate.	Calories.	Flesh gained.	
Oats	10.73	3.59	3.17	51.04	77,209	17.86	5.8
Maize	7.14	3.92	1.28	77.86	100,985	23.36	10.5

The production value and the nutritive ratio being the summation or multiplication of the individual differences in composition are, as is so plainly shown in this table, much better adapted to serve as a basis for a relative valuation of the materials than is any one or all of the separate constituents. As has previously been pointed out, however, it can not be said, in this particular case, that because a hundred pounds of maize will produce an increase in flesh 5.5 pounds greater than can be produced with an equal weight of oats that therefore maize is more valuable than oats; or that because the nutritive ratio of oats is 4.7 lower than that of maize it is consequently of less value. It is true that the amount of productive energy in 100 pounds of maize is greater than in an equal amount of oats by some 23,000 Calories and its intrinsic food value is that much greater; but it is not true that, for all purposes, maize is a more valuable food than oats. It is impossible to compare the value of foods distinctly different in their nature and properties solely by means of any of the factors given in this table or previously discussed.

If, however, two samples or varieties of the same cereal or of two cereals very similar, such as rye and wheat, or emmer and einkorn, or proso and maize, are compared, then, from a consideration of these factors, a just and definite idea of their relative value as animal foods may be formed. A combination of the two factors—production value and nutritive ratio—gives the clearest and most trustworthy basis for such valuation. If two samples of oats or two samples of different cereals of the oat type are compared, it may be said that the one possessing the highest production value and the lowest or narrowest nutritive ratio is the most valuable for the feeding purposes for which oats are used, namely, as producers of muscular energy or working strength.

On the other hand, of two samples of maize, the one possessing the highest production value and the highest or broadest nutritive ratio is the most valuable as a fat-producing food. Of course it is true that differences are not always clean cut, so that allowance must often be made, and a difference in one factor may be more than counterbalanced by that in another; but, nevertheless, it is upon a consideration of these two factors that a true and just valuation of animal foods must be based.

In considering, then, the oats that have been under discussion the question now arises: Have these different varieties of foreign grain changed by their introduction into the United States, and, if so, is this change toward a still more strongly typical oat or in the reverse direction? This is without reference to the effect of the change of environment on the physiological properties of resistance to drought and disease, which must be determined by other studies.

In the tables on the comparison of domestic and foreign grown oats (Tables XVI and XVII, pp. 21 and 22) it is shown that the distinct difference between United States and foreign oats is that the former are higher in protein content and possess a narrower nutritive ratio and sometimes a lower production value. The important difference is not, however, in the production value, but in the nutritive ratio. Upon examination of the tables it appears that the differences in the production values are not great, and, though the foreign oats studied have the highest production values that were found, they are not much above the purely domestic oat, the maximum difference being about 0.25 pound of flesh gained per 100 pounds grain fed, or about 1,000 Calories or 1 Therm, according to the new unit of Armsby. The average production value for the five groups of United States oats given in Table XVI, page 21, is 17.87 pounds of flesh gained or 77,266 Calories, while the average of the three groups of foreign oats is only 18.26 pounds of flesh gained, or 78,954 Calories, a difference of only 0.39 pound of flesh gained, or 1,688 Calories. This difference is not large, especially when it is remembered that the purely domestic oats have a mean production value of 18.11 pounds of flesh gained, only 0.15 pound below the foreign average.

The nutritive ratio, however, shows a very noticeable difference. The nutritive ratio of the domestic oats, with one exception, varies from 1:4.6 to 1:6.6, while that of the foreign is 1:7.0 to 1:7.3. This shows clearly, in another way, the fact previously emphasized that the domestic oat is richer in protein. Table XX shows the different varieties of purely United States oats compared with the three groups of foreign oats.

TABLE XX.—*Different varieties of domestic oats compared with foreign oats.*

[Pounds per hundred pounds of dry matter.]

Variety.	No. of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrate.	Flesh gained.	Calories.	
Domestic oats:								
Rust proof	8	10.39	3.83	3.02	50.60	17.75	76,733	6.0
Culberson Winter	5	9.94	5.15	3.05	50.62	18.36	79,370	6.6
Burt	7	11.19	5.15	2.97	49.02	18.24	78,852	5.7
Snoma	2	10.31	5.17	2.41	52.24	18.69	80,797	6.4
Prince Edward Island	1	13.56	5.17	2.63	47.92	18.44	79,716	4.6
Big Four	1	8.77	3.80	3.91	50.37	17.52	75,739	7.2
White Russian	1	10.87	5.00	2.78	50.70	18.44	79,716	5.9
Mean	25	10.60	4.67	2.98	50.19	18.11	78,377	6.0
Typical U. S. oat, 1898[a]		10.40	4.15	3.46	49.62	17.88	77,395	6.0
Mean U. S. and Canada, 1893[a]	72	10.45	4.07	3.44	49.84	17.80	77,049	6.0
Foreign oats:								
Chamberlain	54	9.07	4.86	2.83	52.28	18.35	79,327	7.3
Kellner[a]		9.26	4.59	3.09	51.69	18.17	78,510	7.0
König[a]	307	9.07	5.02	2.93	51.57	18.28	79,024	7.2

[a] Chamberlain, loc. cit.

These are the results that without question should be used as a basis for the comparison of United States and foreign oats and on which we should decide whether introduced varieties are desirable so far as the effect of the introduction on their composition is concerned. An examination of the three results of (1) a typical United States oat as given in 1898, (2) the mean of 72 United States and Canadian samples in 1893, and (3) the mean of 25 samples of strictly United States oats of 1906 show that the typical oats grown in the United States at the three dates—1893, 1898, and 1906—are very nearly alike, especially in the more important factors—protein, carbohydrate, production value, and nutritive ratio—and that they differ materially from the foreign oats reported in this table.

This shows that the composition of United States oats, as given, is not obtained during one season nor on one variety, but that the average composition of oats grown in such different localities, as shown in the detailed tables given at the close of this bulletin (p. 48) and in different years, is distinctly different in certain points from a similar average composition of foreign oats.

The factor which shows the least variation is the production value. This means that while the amount of the nutritive constituents is different the real nutritive and productive value is only slightly changed. That is, while the food value of the domestic oats remains on the average nearly as high, and in individual instances is higher than the foreign oats, its distinctive character as producing muscle and energy rather than fat is emphasized. Thus, the mean of the purely domestic oats as to production value is only slightly lower than that of the foreign oats, namely, 18.11 pounds of flesh gained, or 78,377 Calories, compared with 18.17 to 18.35 pounds of flesh gained, or 78,510 to 79,327 Calories. The difference in the nutritive ratios is, however, considerable, namely, 1:6.0 and 1:7.2. The loss, therefore, in production value appears to be more than compensated for by the gain in protein over carbohydrate.

It will be seen that the production value of the typical oat of 1893 and 1898, as well as that of the Rust Proof and Big Four varieties, is considerably lower than that of the other domestic oats and of the foreign oats. The cause of the higher production value of these other varieties is that the amount of fat is high, so that the production value is high, while at the same time the ratio of protein to carbohydrate is low.

If one individual variety, for example, domestic Swedish Select, be closely compared with the foreign seed, the same general relations are found to exist. From Tables XVII and XVIII (pp. 22 and 24) it is seen that in twelve States out of twenty the domestic oats increased in protein content over the original foreign seed, in four cases the production value increased, and in all but five the nutritive ratio became narrower.

From four States the protein was approximately equal to the foreign and only four out of the twenty fell below the foreign. The four States yielding oats containing less protein than the foreign seed were: Iowa (8.89), Wisconsin (8.96), Idaho (9.23), and Missouri (9.21), the foreign seed averaging 9.89. With Tobolsk, North Finnish Black, Belgian Winter, Red Algerian, and Shatilov, the only other varieties of which we have the analysis of the foreign seed from which the domestic grain was grown, the same facts are true, with the exception of Shatilov, as previously mentioned.

CONCLUSIONS.

The general conclusion, therefore, in regard to the oats is that the domestic grain is more strongly typical of its class than the foreign-grown oats, and that on introduction into the United States the foreign varieties change somewhat in composition, but this change is toward rather than away from the typical oat—this typical oat being characterized by high protein and narrow nutritive ratio, a grain essentially productive of muscular strength.

Emmer (*Triticum dicoccum*) and Einkorn (*Triticum monococcum*).

These two cereals, emmer (*Triticum dicoccum*) and einkorn (*Triticum monococcum*), belong botanically to the same genus as wheat, but on account of the fact that they are both used as food without the removal of the hull they may better be compared with oats. The large amount of crude fiber reduces the protein and carbohydrate below that of wheat and lowers the production value even to less than that of oats. The nutritive ratio for einkorn likewise falls below that of oats, being as low as 1:5.2. Einkorn is more fibrous than emmer, and has more crude fiber, a lower production value, and a narrower nutritive ratio. Table XXI shows a comparison of emmer, einkorn, and oats.

TABLE XXI.—*Comparison of the total and digestible nutrients of emmer, einkorn, and oats.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Nutrients.								Total production value.		Nutritive ratio.
	Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calories.	
	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.			
Emmer	13.28	9.96	1.91	1.36	11.31	4.98	69.42	52.06	17.20	74,356	6.0
Einkorn	14.67	11.00	2.19	1.55	13.55	5.96	64.02	48.04	16.81	72,670	5.2
Oats	13.76	10.73	4.33	3.59	12.20	3.17	66.29	51.04	17.86	77,209	5.8

The comparison of these three cereals will be discussed more fully in the general conclusion. There being only one sample of foreign emmer no comparison of domestic and foreign grain of these two varieties is possible. The highest protein content of the emmers was in a sample from South Dakota, 1903, No. 1051, having 18.69 pounds of total protein and 14.02 pounds of digestible protein per hundred pounds, the average protein being 13.28 pounds total and 9.96 pounds digestible.

In the case of the einkorn, No. 1065, a sample from Kansas, 1905, had the highest protein content, a total of 16.25 pounds and 12.19 pounds of digestible protein per hundred pounds.

TABLE XXII.—*Emmer and einkorn analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N×6.25).		
						Total.	Digestible.	Production value—gain in flesh.
	Emmer:							
1	Black emmer	Foreign	8.92	91.08	3.88	12.00	9.00	2.11
24	Do	United States	8.68	91.32	4.07	13.28	9.96	2.34
4	Einkorn: Miscellaneous	do	8.34	91.66	5.57	14.67	11.00	2.58

Number of analyses.	Variety.	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
	Emmer:							
1	Black emmer	Foreign	1.47	1.04	0.55	10.72	4.72	1.17
24	Do	United States	1.91	1.36	.71	11.31	4.98	1.24
4	Einkorn: Miscellaneous	do	2.19	1.55	.81	13.55	5.96	1.48

TABLE XXII.—*Emmer and einkorn analyses—average results*—Continued.

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
	Emmer:							
1	Black emmer	Foreign	71.93	53.95	13.38	17.21	74,399	6.8
24	Do	United States.	69.42	52.06	12.91	17.20	74,356	6.0
4	Einkorn: Miscellaneous	do	64.02	48.04	11.94	16.81	72,670	5.2

WHEAT (*Triticum vulgare*).

The wheat samples analyzed for this investigation comprise only a small number representing the principal classes of American wheat and a few samples of American and foreign durum. In explanation of the seeming neglect of this important cereal, it may be said that the primary object of this study was the analysis of oats, barley, rye, emmer, einkorn, proso, and sorghum; wheat and maize were only introduced when it became desirable to report the chemical results alone in the form of a bulletin. Furthermore, there have been many extended series of analyses made of both of these cereals, and for the purposes of comparison such results can readily be used.

The digestible nutrients in the wheat samples analyzed and in typical groups as taken from other sources are given in Table XXIII.

TABLE XXIII.—*Wheat—digestible nutrients, production value, and nutritive ratio.*

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrates.	Calories.	Flesh gained.	
Foreign durum	3	14.17	1.42	1.13	70.56	94,501	21.86	5.3
Domestic durum	12	13.02	1.72	1.33	70.77	94,457	21.85	5.8
Northwest Spring, United States	4	11.78	1.41	1.17	73.04	94,717	21.91	6.6
Kansas Winter, United States	3	11.06	1.14	1.31	73.55	94,068	21.76	7.0
Soft Winter, United States	5	9.96	1.20	1.17	75.24	94,760	21.92	7.9
United States wheat, 1893 [a]	166	10.48	1.25	1.24	74.27	94,460	21.85	7.5
Canada wheat, 1893 [a]	49	10.62	1.28	1.20	74.28	94,635	21.89	7.4
English wheat (König) [b]	15	9.72	2.15	1.57	74.43	96,235	22.26	8.3
Russian wheat (König) [c]	33	14.82	1.15	1.19	69.85	93,809	21.70	4.9
Germany Spring (König) [d]	30	13.22	1.13	[e] 1.53	[e] 62.75	84,905	19.64	5.0
Winter (König) [d]	42	10.87	1.24	1.53	63.99	84,080	19.45	6.3
Typical United States wheat [f]		10.50	1.23	1.26	73.33	93,465	21.62	7.4

[a] U. S. Dept. Agr., Bureau of Chemistry, 1895, Bul. 45, pp. 45, 47.
[b] Loc. cit., p. 422.
[c] Loc. cit., p. 421.
[d] Loc. cit., p. 418, 419.
[e] Calculated.
[f] U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1189.

No direct comparison can be made between foreign and domestic wheat, as was done with both oats and barley, because the domestic grain was not the product of directly introduced foreign wheat. In the case of the durum wheat this was true in a general way, but not as with the other cereals.

It will be readily seen that the highest protein wheats are those from Russia, while the spring wheats of North Germany and the durum and spring wheats of the United States rank next. While the highest production value occurs in the English wheat which is very low in protein, all of the hard wheats high in protein are likewise high in total production value. The actual production value is much higher for wheat than for any of the other energy-producing cereals. This is readily explained because of the small amount of crude fiber present, almost the entire amount of nitrogen-free extract constituents being in the form of true carbohydrate which possesses a relatively high coefficient of digestibility.

While the effect of introduction on European oats and barley is to increase the protein content, the effect produced on Russian durum wheat, which is originally a very hard, high protein wheat, is, at least in most localities, to lower the protein content to some extent. Other results, however, show that in the drier semiarid regions of the United States the protein content even of Russian durum wheat is maintained or may even be increased, so that this is not really any exception to the general effect of introduction on foreign-grown cereals.

The hard wheats, possessing, as they do, a large amount of protein, have a narrow nutritive ratio, so that taken together with the high production value they are naturally the most concentrated of the energy-producing cereals of the oat class.

TABLE XXIV.—*Wheat analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N×5.7).			Fat.			Crude fiber.		
						Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
3	Durum	Russia	11.02	88.98	1.78	16.87	14.17	3.33	2.25	1.42	0.75	2.40	1.13	0.28
1	*T. vulgare*	do	9.43	90.57	1.85	16.76	14.07	3.31	1.72	1.08	.57	2.45	1.15	.28
1	*T. sativum*	India	9.58	90.42	2.30	11.97	10.05	2.36	2.62	1.65	.87	3.06	1.44	.36
12	Durum	United States	9.77	90.23	2.02	15.50	13.02	3.06	2.73	1.72	.91	2.83	1.33	.33
4	Northwest spring	do	10.11	89.89	1.85	14.02	11.78	2.77	2.24	1.41	.74	2.50	1.17	.29
3	Kansas winter	do	10.68	89.32	2.28	13.17	11.06	2.60	1.81	1.14	.60	2.79	1.31	.32
5	Soft winter	do	10.55	89.45	2.00	11.86	9.96	2.34	1.91	1.20	.63	2.49	1.17	.29
24	All varieties	do	10.10	89.90	2.02	14.20	11.93	2.80	2.36	1.49	.78	2.78	1.30	.32

TABLE XXIV.—*Wheat analyses—average results*—Continued.

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
3	Durum	Russia	76.70	70.56	17.50	21.86	94,501	5.3
1	*T. vulgare*	do	77.22	71.04	17.62	21.76	94,068	5.3
1	*T. sativum*	India	80.05	73.65	18.26	21.85	94,457	7.8
12	Durum	United States	76.92	70.77	17.55	21.85	94,457	5.8
4	Northwest spring	do	79.39	73.04	18.11	21.91	94,717	6.6
3	Kansas winter	do	79.95	73.55	18.24	21.76	94,068	7.0
5	Soft winter	do	81.77	75.24	18.66	21.92	94,760	7.9
24	All varieties	do	78.72	72.42	17.96	21.86	94,515	6.5

RYE (*Secale cereale*).

As a feeding grain rye is very similar to wheat, the two being more nearly alike in the essential points, namely, protein content, production value, and nutritive ratio, than any other two cereals.

There are no foreign varieties among the samples of rye analyzed in this study, so that a direct comparison of the introduced varieties with the same varieties grown abroad was impossible. From other analyses made in this country and from analyses reported by König a comparison somewhat similar to that made with oats and barley is possible. In Table XXV the results obtained in this study and those obtained in 1893 and 1898 by the Bureau of Chemistry are compared with foreign rye, the analyses of which are reported by König:

TABLE XXV.—*Rye—total and digestible nutrients, production value, and nutritive ratio.*

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Nutrients.								Production value.		Nutritive ratio.
		Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calories.	
		Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.			
Domestic:												
All varieties, 1906	17	13.44	11.29	1.83	1.17	2.30	1.22	80.24	73.82	21.87	94,544	6.9
Typical United States, 1898 [a]		13.69	11.50	1.67	1.07	2.35	1.25	80.17	73.76	21.86	94,502	6.7
All United States, 1893 [b]	18	13.91	11.68	1.85	1.18	2.34	1.24	79.85	73.46	21.90	94,680	6.6
Foreign: German (König) [c]	119	12.89	10.83	1.88	1.20	3.02	1.60	79.78	73.40	21.78	94,178	7.2

[a] U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1184.
[b] U. S. Dept. Agr., Bureau of Chemistry, 1893, Bul. 45, p. 37.
[c] Loc. cit., p. 474.

While the foreign and domestic ryes in Table XXV have no direct relation to each other, as in the case of the oats and barley, and while the differences are not large, it will be noticed that the same general relation exists here as with the other cereals, namely, that the United

States grain is higher in protein than the foreign. In the case of rye, the production value also is higher. The domestic samples, also, though analyzed in three different years, agree more closely with each other than they do with the foreign-grown grain.

From an examination of Table XLII, page 57, it will be seen that the rye with the highest protein content is a sample of Ivanov, grown in Kansas in 1905 (No. 1070), the total protein amounting to 17.44 pounds per 100 pounds, or 14.65 pounds digestible. The three samples with the highest protein content represent each of the varieties examined and were grown in the States of Kansas and Nebraska, the total protein in these three samples being for No. 1070, 17.44 pounds; for No. 1082, 16.44 pounds; and for No. 1076, 15.62 pounds per hundred pounds. The digestible protein equals 14.65 pounds, 13.81 pounds, and 13.12 pounds, respectively. The nutritive ratios of these samples are the narrowest of all the samples, being 1 : 5.0, 5.4, and 5.8, respectively.

TABLE XXVI.—*Rye analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety	Locality.	Water.	Dry matter.	Ash.	Protein (N×6.25).		
						Total.	Digestible.	Production value—gain in flesh.
6	Ivanov	United States.	9.39	90.61	2.15	12.88	10.82	2.54
5	Abbruzzes	do	9.18	90.82	2.23	13.46	11.31	2.66
5	Spring	do	9.58	90.42	2.14	14.18	11.91	2.80
1		do	9.37	90.63	2.27	13.06	10.97	2.58
17	All varieties	do	9.38	90.62	2.18	13.44	11.29	2.65

Number of analyses.	Variety	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
6	Ivanov	United States.	1.84	1.18	0.62	2.39	1.27	0.31
5	Abbruzzes	do	1.83	1.17	.61	2.24	1.19	.29
5	Spring	do	1.82	1.16	.61	2.23	1.18	.29
1		do	1.84	1.18	.62	2.47	1.31	.32
17	All varieties	do	1.83	1.17	.61	2.30	1.22	.30

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
6	Ivanov	United States.	80.73	74.27	18.42	21.89	94,630	7.2
5	Abbruzzes	do	80.24	73.82	18.31	21.87	94,544	6.9
5	Spring	do	79.63	73.26	18.17	21.87	94,544	7.1
1		do	80.36	73.93	18.33	21.85	94,457	7.1
17	All varieties	do	80.24	73.82	18.31	21.87	94,544	6.9

BARLEY (*Hordeum vulgare*).

The barleys which were studied in this investigation comprise 8 samples of imported grain representing four varieties and 123 samples of grain grown in the United States representing 16 varieties. A comparison of the composition of these various samples with that of other compiled analyses is shown in Table XXVII.

TABLE XXVII.—*Comparison of barley analyses by groups, domestic and foreign.*

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Moisture.	Ash.	Protein.	Fat.	Crude fiber.	Carbohydrate.
Typical United States, 1898[a]		10.85	2.80	12.34	2.52	4.32	78.02
United States and Canadian, 1893[b]	32	10.80	2.74	11.98	2.39	4.54	78.35
North and middle Germany[c]	98	12.95	3.52	11.50	2.15	4.86	77.97
Foreign samples, 1906	8	9.38	2.81	12.52	2.06	4.58	78.03
United States, 1906	123	9.32	3.04	13.39	1.87	5.64	76.05
Hull-less, 1906	5	9.07	2.36	16.09	1.90	2.64	77.01

[a] U. S. Dept. Agr., Bureau of Chemistry, 1898, Bul. 13, Pt. IX, p. 1173.
[b] U. S. Dept. Agr., Bureau of Chemistry, 1895, Bul. 45, p. 14.
[c] König, Chemie der menschlichen Nahrungs- und Genussmittel, 1903, p. 508 (recalculated to dry basis).

A difference at once observed on examining this table is that the barleys grown in the United States in 1906 have a higher protein content than the foreign barleys analyzed at the same time. This is also true, to a less degree, of the United States barleys of 1893 and 1898 compared with the analyses reported by König.

It would naturally be expected that the United States barleys would be higher in protein because in this country high protein barleys are considered the best for brewing purposes, while in Europe the best brewing barleys are considered to be those low in protein. Although the barleys studied in this investigation belong to the feeding class rather than to the brewing, the tendency in this country to grow for high protein and in Europe for low protein would have an effect on both feeding and brewing barleys in general. The digestible nutrients, production values, and nutritive ratios of these barleys is shown in Table XXVIII.

TABLE XXVIII.—*Barley—digestible nutrients averaged by groups, domestic and foreign.*

[Pounds per hundred pounds of dry matter.]

Description of samples.	Number of samples.	Digestible nutrients.				Production value.		Nutritive ratio.
		Protein.	Fat.	Crude fiber.	Carbohydrate.	Calories.	Flesh gained.	
Typical United States		8.64	2.24	1.42	71.78	92,339	21.36	9.0
United States and Canada, 1893	32	8.39	2.13	1.50	72.08	92,253	21.34	9.3
Foreign (König)	98	8.05	1.91	1.60	71.73	91,086	21.07	9.6
Foreign, 1906	8	8.76	1.83	1.51	71.78	91,604	21.19	8.8
United States, 1906	123	9.37	1.66	1.86	69.96	90,264	20.88	8.0
Hull-less	5	11.26	1.69	.87	70.85	92,166	21.32	6.7

The same general facts are again shown as were found in the case of the oats, namely, the foreign-grown grain is poorer in protein and richer in carbohydrate; higher in production value and broader in nutritive ratio. A comparison of individual varieties (Table XXIX), of which both foreign and domestic samples were analyzed, shows the same relations to exist.

TABLE XXIX.—*Comparison of domestic and foreign barley, averaged by varieties.*

[Pounds per hundred pounds of dry matter.]

Variety.	Number of samples.	Nutrients.								Production value.		Nutritive ratio.
		Protein.		Fat.		Crude fiber.		Carbohydrate.				
		Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Calories.	Fat gained.	
Black Arabian:												
Foreign	5	12.52	8.76	2.11	1.88	4.79	1 58	77.82	71.59	91,604	21.19	8.8
United States	6	14.04	9.83	2.03	1.81	4.92	1.62	75.84	69.77	90,610	20.96	7.7
Swan Neck:												
Foreign	1	13.94	9.76	2.18	1.94	4.06	1.34	76.78	70.63	91,475	21.16	7.8
United States	5	14.49	10.14	2.20	1.96	4.52	1.49	76.06	69.97	91,345	21.13	7.5
Kitzing:												
Foreign	1	11.82	8.27	1.94	1.73	4.15	1.37	79.24	72.90	91,950	21.27	9.4
United States	2	15.25	10.67	2.00	1.78	4.36	1.44	75.56	69.51	90,912	21.03	7.0
Fan:												
Foreign	1	11.75	8.22	1.77	1.58	4.50	1.48	79.14	72.81	91,604	21.19	9.5
United States	1	14.62	10.23	1.79	1.59	5.04	1.66	75.52	69.48	90,264	20.88	8.3

In every case where the same variety was grown in its original foreign home and then later in the United States it increased in protein and the nutritive ratio became narrower, while the production value decreased very slightly. The resulting effect, therefore, is the production of a better feeding barley than the original.

An examination of the table of averages for barley (Table XXXI) will show that the maximum protein content was found in the two United States samples of Kitzing, namely, total, 15.25 pounds per 100 pounds, or 10.67 pounds digestible, the carbohydrate in the same sample being 75.56 pounds total and 69.51 pounds digestible. The lowest protein content, on the other hand, was found in the eight foreign-grown samples, namely, 12.52 pounds total and 8.76 pounds digestible, the carbohydrate in the same samples being 78.03 pounds total and 71.78 pounds digestible. The production value of the United States Kitzing was 21.03 pounds of flesh gained or 90,912 Calories and of the foreign samples 21.19 pounds of flesh gained or 91,604 Calories, the nutritive ratio being 1:7.0 for the domestic and 1:8.8 for the foreign. It is noticeable that in this variety (Kitzing) the protein content is the highest of all, while at the same time the production value is only slightly lower than that of the foreign-grown grain. The same can be said in general of the varieties Swan Neck, Hanna, and Princess. This means that these varieties are especially adapted for use as feeding barleys, having a high protein content, a narrow nutritive ratio, and at the same time a high production value.

Table XXX gives the varieties of barley considered in the order of their protein content, together with their production values and nutritive ratios.

TABLE XXX.—*Barleys arranged in order of protein content.*

[Pounds per hundred pounds of dry matter.]

Variety.	Protein.	Production value, flesh gained.	Nutritive ratio.
Hull-less	16.09	21.32	6.7
Kitzing	15.25	(5)[a] 21.03	7.0
Swan Neck	14.49	(2) 21.13	7.5
Black Arabian	14.04	(7) 20.96	7.7
Black Smyrna	13.98	(8) 20.85	7.6
Hanna	13.82	(3) 21.04	7.8
Manchuria	13.44	(11) 20.68	7.9
Princess	13.42	(4) 21.04	8.1
Telli	13.08	(12) 20.65	8.1
Beldi	12.92	(10) 20.69	8.3
Tennessee Winter	12.84	(9) 20.81	8.4
White Smyrna	12.49	(6) 21.02	8.8
Foreign: Black Arabian	12.52	(1) 21.19	8.8

[a] Figures in parentheses express order according to production value.

It will be noticed that the order of the nutritive ratio is exactly the reverse of that of the protein content; that is, the higher the protein content the lower or narrower the nutritive ratio. This is, of course, as would be expected. In regard to the production value, while it is true that the foreign samples with low protein and correspondingly high carbohydrate have the higher production value, some of the domestic samples with high protein have also a high production value. This is due to the fact that the fat content is high or the crude fiber low and is especially noticeable with the varieties Kitzing, Swan Neck, Hanna, and Princess.

Some individual cases may be noticed showing the maximum and minimum limits in protein content, etc. The highest protein content of all individual samples, excepting the hull-less varieties, is found in No. 1102, Hanna, South Dakota, 1904, third crop after introduction, total protein, 19.94 pounds per 100 pounds; digestible protein, 13.61 pounds. The production value of this sample is 20.59 pounds flesh gained and the nutritive ratio is 1:5.2. The lowest protein content occurs in the case of No. 1185, Princess, California, 1902, first crop after introduction, the total protein amounting to 8.44 pounds, and the digestible protein to 5.91 pounds, the production value being 21.32 pounds of flesh gained and the nutritive ratio 1:13.6. The highest production value is found for No. 1215, Giant Winter, Oregon, 1904, second crop after introduction, the production value being

21.72. The nutritive ratio in this case is 1:12.4 and the digestible protein amounts to 6.56 pounds. No. 1165, Beldi, South Dakota, 1905, third crop after introduction, shows the lowest production value, namely 20.24 pounds of flesh gained, the nutritive ratio in this case being 1:6.2, and the digestible protein, 11.37 pounds. From these cases and from an examination of the complete table (Table XLIII, p. 58) it will be seen that, as has been stated, a high protein usually corresponds to a low production value and a narrow nutritive ratio. In the cases just cited the barley having the highest protein content has a production value only a little higher than the lowest and, vice versa, the one having the highest production value has a protein content only slightly higher than the lowest.

Therefore, for the best feeding barleys, it is essential to secure in one sample or variety a high protein and narrow nutritive ratio, while at the same time the production value remains high. For barleys, then, as for oats, the general conclusion is that the effect of introduction appears to be to increase the protein content and to narrow the nutritive ratio. At the same time the total production value is slightly diminished, but in even a less degree than in the case of oats.

The effect of the introduction has been therefore to improve the barleys as a feeding grain, the tendency being toward the production of those characters, mentioned in the preceding paragraph, which are essential to the best barleys for such purposes.

TABLE XXXI.—*Barley analyses—average results.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N × 6.25).		
						Total.	Digestible.	Production value—gain in flesh.
5	Black Arabian	Foreign	9.43	90.57	2.75	12.52	8.76	2.06
3	Miscellaneous	do	9.30	90.70	2.91	12.50	8.75	2.06
8	Average		9.38	90.62	2.81	12.52	8.76	2.06
6	Black Arabian	United States	9.59	90.41	3.16	14.04	9.83	2.31
32	Hanna	do	9.44	90.56	2.97	13.82	9.67	2.27
23	Tennessee winter	do	9.50	90.50	3.17	12.84	8.99	2.11
5	Swan Neck	do	9.30	90.70	2.74	14.49	10.14	2.38
2	Kitzing	do	9.35	90.65	2.83	15.25	10.67	2.51
12	Beldi	do	9.05	90.95	3.15	12.92	9.04	2.12
10	Black Smyrna	do	9.55	90.45	3.05	13.98	9.79	2.30
4	Princess	do	9.55	90.45	2.85	13.42	9.39	2.21
12	Telli	do	8.89	91.11	3.01	13.08	9.16	2.15
10	White Smyrna	do	9.06	90.94	2.95	12.49	8.74	2.05
7	Miscellaneous	do	8.98	91.02	3.15	13.18	9.23	2.17
123	Average		9.32	90.68	3.04	13.39	9.37	2.20
5	Hull-less	United States	9.07	90.93	2.36	16.09	11.26	2.65

TABLE XXXI.—*Barley analyses—average results*—Continued.

Number of analyses.	Variety.	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
5	Black Arabian	Foreign	2.11	1.88	0.99	4.79	1.58	0.39
3	Miscellaneous	do	1.96	1.74	.92	4.24	1.40	.35
8	Average		2.06	1.83	.96	4.58	1.51	.37
6	Black Arabian	United States	2.03	1.81	.95	4.92	1.62	.40
32	Hanna	do	1.97	1.75	.92	4.66	1.54	.38
23	Tennessee winter	do	1.78	1.58	.83	6.02	1.99	.49
5	Swan Neck	do	2.20	1.96	1.03	4.52	1.49	.37
2	Kitzing	do	2.00	1.78	.94	4.36	1.44	.36
12	Beldi	do	1.90	1.69	.89	7.11	2.35	.59
10	Black Smyrna	do	1.88	1.67	.88	5.68	1.87	.47
4	Princess	do	1.73	1.54	.81	4.67	1.54	.38
12	Telli	do	1.68	1.50	.79	7.12	2.35	.58
10	White Smyrna	do	1.85	1.65	.87	5.32	1.76	.44
7	Miscellaneous	do	1.66	1.48	.78	6.58	2.17	.54
123	Average		1.87	1.66	.87	5.64	1.86	.46
5	Hull-less	United States	1.90	1.69	.89	2.64	.87	.21

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
5	Black Arabian	Foreign	77.82	71.59	17.75	21.19	91,604	8.8
3	Miscellaneous	do	78.39	72.12	17.88	21.21	91,690	8.8
8	Average		78.03	71.78	17.80	21.19	91,604	8.8
6	Black Arabian	United States	75.84	69.77	17.30	20.96	90,610	7.7
32	Hanna	do	76.57	70.44	17.47	21.04	90,956	7.8
23	Tennessee winter	do	76.19	70.10	17.38	20.81	89,962	8.4
5	Swan Neck	do	76.06	69.97	17.35	21.13	91,345	7.5
2	Kitzing	do	75.56	69.51	17.24	21.03	90,912	7.0
12	Beldi	do	74.91	68.92	17.09	20.69	89,443	8.3
10	Black Smyrna	do	75.40	69.36	17.20	20.85	90,134	7.6
4	Princess	do	77.32	71.13	17.64	21.04	90,956	8.1
12	Telli	do	75.10	69.09	17.13	20.65	89,270	8.1
10	White Smyrna	do	77.39	71.20	17.66	21.02	90,869	8.8
7	Miscellaneous	do	75.34	69.31	17.19	20.68	89,400	8.1
123	Average		76.05	69.96	17.35	20.88	90,264	8.0
5	Hull-less	United States	77.01	70.85	17.57	21.32	92,166	6.7

PROSO (*Panicum miliaceum*) AND SORGHUM (*Andropogon sorghum*).

These two grains, the proso or broom corn millet and the nonsaccharine sorghums, may be considered together, as were the emmer and einkorn. They, however, differ more from each other than do the latter grains because of the considerable amount of crude fiber in the proso and the small amount in the sorghum. This gives to the sorghum a higher carbohydrate content and a higher production value. In protein content and in nutritive ratio, however, they are very similar, and in these and also in production value they both have the general characteristics of maize and belong to the same class.

TABLE XXXII.—*Group averages of total and digestible nutrients of proso, sorghum, and maize.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Nutrients.								Total production value.		Nutritive ratio.
	Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calories.	
	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.			
Proso	12.77	6.28	3.27	2.51	8.95	6.11	71.23	60.69	19.37	83,736	11.5
Sorghum	11.71	7.61	3.25	2.27	1.80	.92	81.58	74.24	21.62	93,463	10.5
Maize	9.91	7.14	4.40	3.92	2.21	1.28	81.96	77.86	23.36	100,985	12.3

Proso and sorghum, like maize, are lower in protein and higher in carbohydrate, giving higher production value and broader nutritive ratio than the other cereals and thus stand at the opposite extreme from oats.

Of the prosos (Table XLIV), the highest protein content is found for No. 1022 from Oklahoma, namely, 16.87 pounds, digestible protein 8.30 pounds per 100 pounds, giving to this sample the narrowest nutritive ratio (1:8.2) and the lowest production value, 18.70 pounds gain in flesh. The highest carbohydrate content was found in a Colorado sample, No. 1029, with 75.22 pounds total and 64.09 pounds digestible. This gives a production value of 19.76 pounds gain in flesh, which is the highest with one exception, No. 1016, for which the nutritive ratio is 1:14.6, the broadest of the entire list. The average protein content is 12.77 pounds total and 6.28 pounds digestible. The average production value and nutritive ratio are, respectively, 19.37 pounds gain in flesh, or 83,736 Calories, and 1:11.5.

Of the sorghums the highest protein content is in No. 771, which has 14.50 pounds total and 9.42 pounds digestible, the nutritive ratio being relatively narrow, namely, 1:8.2. The highest carbohydrate content is found in No. 770 with 85.31 pounds total and 77.64 pounds digestible. This sample has a production value of 21.71 pounds gain in flesh, the maximum being 21.87 pounds in No. 781. It has the broadest nutritive ratio of any of the samples examined, namely, 1:14.3. The average composition of the sorghum samples is given in Table XXXIII.

TABLE XXXIII.—*Proso, sorghum, and maize analyses—average results for the United States.*

[Pounds per hundred pounds of dry matter.]

Number of analyses.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N × 6.25).		
						Total.	Digestible.	Production value—gain in flesh.
	Proso:							
17	Red Orenburg	United States.	8.98	91.02	3.59	12.84	6.32	1.49
9	Red Voronezh	do	8.83	91.17	4.03	13.08	6.43	1.51
10	Black Voronezh	do	8.80	91.20	3.82	12.27	6.04	1.42
2	Yellow Manitoba	do	9.54	90.46	4.10	13.37	6.58	1.55
38	Average	do	8.93	91.07	3.78	12.77	6.28	1.48
10	Sorghum: Miscellaneous	do	11.71	88.29	1.75	11.71	7.61	1.79
12	Maize: Miscellaneous	do	13.06	86.94	1.52	9.91	7.14	1.68

Number of analyses.	Variety.	Locality.	Fat.			Crude fiber.		
			Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.
	Proso:							
17	Red Orenburg	United States.	3.29	2.53	1.33	8.56	5.85	1.45
9	Red Voronezh	do	3.09	2.38	1.25	9.72	6.64	1.65
10	Black Voronezh	do	3.33	2.56	1.35	8.84	6.04	1.50
2	Yellow Manitoba	do	3.52	2.71	1.43	9.32	6.37	1.58
38	Average	do	3.27	2.51	1.32	8.95	6.11	1.52
10	Sorghum: Miscellaneous	do	3.25	2.27	1.19	1.80	.92	.23
12	Maize: Miscellaneous	do	4.40	3.92	2.06	2.21	1.28	.32

Number of analyses.	Variety.	Locality.	Carbohydrate.			Total production value.		Nutritive ratio.
			Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
	Proso:							
17	Red Orenburg	United States.	71.71	61.10	15.15	19.42	83,953	11.5
9	Red Voronezh	do	70.09	59.71	14.81	19.22	83,088	11.2
10	Black Voronezh	do	71.74	61.12	15.16	19.43	83,996	12.1
2	Yellow Manitoba	do	69.68	59.38	14.72	19.28	83,347	10.9
38	Average	do	71.23	60.69	15.05	19.37	83,736	11.5
10	Sorghum: Miscellaneous	do	81.58	74.24	18.41	21.62	93,463	10.5
12	Maize: Miscellaneous	do	81.96	77.86	19.31	23.36	100,985	12.3

MAIZE (*Zea mays*).

The analyses of maize given in the tables were made for another study, but they have been used here for the purpose of comparison and because no samples of this cereal were included among those first examined for the present investigation.

A comparison of the analyses reported in this bulletin with those given by the Bureau of Chemistry in previous bulletins and with those reported by König is given in Table XXXIV.

Table XXXIV.—*Maize—digestible nutrients averaged by groups.*

[Pounds per hundred pounds of dry matter.]

Character of samples.	Number of samples.	Nutrients.								Production value.		Nutritive ratio.
		Protein.		Fat.		Crude fiber.		Carbohydrate.		Gain in flesh.	Calories.	
		Total.	Digestible.	Total.	Digestible.	Total.	Digestible.	Total.	Digestible.			
Domestic, United States, 1906	12	9.90	7.14	4.40	3.92	2.21	1.28	81.96	77.86	23.36	100,985	12.3
Typical, United States, 1898	......	11.21	8.05	4.76	4.28	1.96	.80	80.40	76.38	23.28	100,640	10.8
World's Fair, 1893	18	11.09	7.98	4.68	4.21	1.92	.79	80.78	76.74	23.31	100,770	10.9
Jenkins and Winton	208	11.78	8.48	6.06	5.45	2.36	.97	78.12	74.20	23.50	101,590	10.3
Foreign, König	137	10.91	7.85	4.95	4.45	2.64	1.08	80.01	76.01	23.39	101,115	11.1

From Table XXXIV it is seen that while the domestic maize analyzed in 1906 is considerably lower in protein than the other United States samples and than the foreign, the difference between domestic and foreign grain does not seem to be as marked in this case as with some of the other cereals. In the production value the difference is even less, the extreme variation being only 0.22 pound of flesh gained. The most striking point, however, is that the production value is much higher and the nutritive ratio much broader in the case of maize than for any other cereal.

GENERAL SUMMARY.

Considering, now, the general results in regard to the feeding value of the cereal grains as obtained in this study it appears that, as feeding materials, they fall into three classes typical of the three grains most commonly used, namely, wheat, oats, and maize (or corn). Within one or the other of these groups all of the cereals may be included. This is equally true of those grains commonly grown, such as barley and rye, and of those much less common, such as emmer and proso. Collecting the results as given in the tables of averages (Tables XVIII, XXII, XXIV, XXVI, XXXI, XXXIII) it is seen how distinct this grouping is.

Table XXXV.—*Oat group—digestible nutrients.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Protein.	Fat.	Crude fiber.	Carbohydrate.	Production value—gain in flesh.	Nutritive ratio.
Oats	10.73	3.59	3.17	51.04	17.86	5.8
Emmer	9.96	1.36	4.98	52.06	17.20	6.0
Einkorn	11.00	1.55	5.96	48.04	16.81	5.2

TABLE XXXVI.—*Wheat group—digestible nutrients.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Protein.	Fat.	Crude fiber.	Carbohydrate.	Production value—gain in flesh.	Nutritive ratio.
Wheat	11.93	1.49	1.30	72.42	21.86	6.5
Barley	9.37	1.66	1.86	69.96	20.88	8.0
Rye	11.29	1.17	1.22	73.82	21.87	6.9

TABLE XXXVII.—*Maize group—digestible nutrients.*

[Pounds per hundred pounds of dry matter.]

Cereal.	Protein	Fat.	Crude fiber.	Carbohydrate.	Production value—gain in flesh.	Nutritive ratio.
Maize	7.14	3.92	1.28	77.86	23.36	12.3
Proso	6.28	2.51	6.11	60.69	19.37	11.5
Sorghum	7.61	2.27	.92	74.24	21.62	10.5

OAT GROUP.

In the oat group, as was stated in the introduction, are found those grains which, being high in protein and high in crude fiber, are low in carbohydrate and possess a relatively lower production value and a narrow nutritive ratio. The production value alone can not, however, be taken as a basis for judgment of the value of these grains as feeds.

It is due to the large amount of crude fiber that the amount of digestible carbohydrate is low, thus lowering the production value. At the same time, however, this low carbohydrate makes the relative amount of protein to carbohydrate high, and the grains are characterized as high protein, energy-producing foods rather than heat-producing like those rich in carbohydrate.

The value, therefore, of the oat class of cereals is that they possess high protein and a narrow nutritive ratio. With the less common grains, emmer and einkorn, it is seen that while the protein in emmer is somewhat lower, the production value and nutritive ratio are nearly the same as that of oats. Einkorn, owing to higher crude fiber, falls below the other two in production value and nutritive ratio. It is plain, however, that both of these grains belong in the oat class rather than in the wheat class. While in fat content they resemble wheat and not oats, and in protein content they could be classed with either, as this factor alone is almost the same in the two classes, the large amount of crude fiber, with its resulting effect upon production value and nutritive ratio, places them definitely with the oats. The hulled emmer would, if fed as such, be as much like wheat as it is, unhulled, like oats. As to the intrinsic nutritive value of these three grains of the oat class, our only criterion is the actual production value in Calories of heat energy which 100 pounds of each grain possesses. From this point of view they would rank as follows: Oats, having a value of 17.86 pounds of flesh gained per 100 pounds of grain fed, or 77,209 Calories of heat energy; emmer, with 17.20 pounds of flesh gained, or 74,356 Calories, and einkorn with 16.81 pounds of flesh gained, or 72,670 Calories. These differences in production value are not, however, important, since equal differences are often found between samples of each one of these grains themselves. The average protein content of emmer is nearly 1 per cent lower than that of oats, yet there are 108 samples out of 242 of United States oats which have a protein content less than the average of the emmer, and 7 samples of emmer out of 25 have a higher protein content than the average of the oats. The maximum protein content for emmer was found in the case of No. 1051, with 14.02 pounds of digestible protein, the maximum in the case of the oats being No. 1297, with 15.40 pounds of digestible protein; the minimum protein content for emmer was 6.47 pounds digestible, and for oats 7.12 pounds. For the production value the variations are less marked. Only 21 samples of oats out of 242 fall below 17.20 pounds, the average production value for emmer, while the maximum value for emmer is 17.59 pounds (No. 1061), which is below the average for oats, the maximum production value of einkorn being 17.04 pounds for No. 1068.

While, therefore, there is considerable natural difference between emmer and einkorn on the one hand and oats on the other, this difference seems to be no more marked than similar differences between different samples of oats. For feeding purposes then, the less common cereals, emmer and einkorn, when used without the removal of the hulls, may be considered as belonging with oats in the group of high protein, muscle, or energy-producing foods and nearly equal to the latter in intrinsic food value.

WHEAT GROUP.

In the wheat group of cereals are the three common grains—wheat, barley, and rye. This group is characterized by high protein, as is the oat group, but differs from it in having low crude fiber, which results in a high digestible carbohydrate. The production value is, therefore, high and the nutritive ratio broader than in the oat group, though not broad as compared with other high carbohydrate foods. In this group, therefore, are found foods which, although high in carbohydrate and in intrinsic food value, yet, because of their high protein, possess an average nutritive ratio and are muscle producing rather than heat producing. On this account wheat has been considered the standard feeding grain where fattening was not the sole object.

When compared with each other and judged by their production values the three members of this group will rank wheat, rye, and barley, the wheat and rye being practically identical in their production value, though the nutritive ratio is narrower and the protein higher in the wheat. These two grains, therefore, are more nearly alike in their composition and value than any other two cereals.

In the case of barley there is a greater difference, due primarily to a considerably lower protein content. This, together with a higher crude fiber, makes the production value lower and the nutritive ratio broader than either of the other two members of this group. Four samples of barley had a protein content higher than the average for wheat, but no barley equaled the wheat average in production value. The effort, however, in this country to grow and breed barleys for high-protein content will probably result in raising the average in this respect and in producing feeding barleys that are more nearly equal to wheat in value.

MAIZE GROUP.

In the last group of cereals—the maize group—are found grains more distinctly different from the other two groups than these are from each other. While the other two groups are similar in being high-protein, energy-producing foods, the maize-group cereals are low in protein. Maize, the typical cereal of the group, is characteristically a high carbohydrate, fat or heat producing food, and because of its relatively low protein possesses a very broad nutritive ratio. The intrinsic food value is higher than that of any of the other cereals. Taken as a group, however, the two distinguishing characteristics are low-protein content and broad nutritive ratio.

The two less common cereals, proso and nonsaccharine sorghum, plainly belong to the maize group when judged by these two standards. In production value both the proso and the sorghum are lower than wheat and rye, and in crude fiber proso is more like the oat group, yet the protein in both is very low and the nutritive ratio much broader than any other cereal except maize. In fat content proso and sorghum are higher than all others except oats and maize. Proso differs from maize and sorghum principally in the amount of crude fiber, which necessarily lowers the amount of digestible carbohydrate. The nutritive ratio, however, is broader than that of sorghum.

Therefore, while proso and sorghum clearly belong with maize in the group of low protein, broad nutritive ratio, fat or heat producing foods, in their intrinsic food value they fall considerably below it. Sorghum in this respect is of about equal value with wheat, while proso is below that of barley, though above oats, maize being higher in its food value than any other cereal.

CONCLUSIONS.

The conclusions drawn from the work presented in this bulletin may be expressed as follows:

(1) The effect of the introduction into the United States of foreign varieties of cereals has been to increase the protein content of the grain. Only two cereals were studied in regard to this point, namely, oats and barley. With both of these grains this increase in protein is an improvement. It increases the high-protein, muscle-producing value of the oats and raises the intrinsic food value of the barley, so that it becomes more nearly equal to that of wheat. Selection and breeding for high-protein content in feeding barleys is a distinct improvement in their value for this purpose.

(2) As feeding grains the cereals may be grouped into three classes typified by our three most common grains, namely, (*a*) oat group, (*b*) wheat group, (*c*) maize group.

Of these three groups the oat group stands at one end as a typical muscle or energy producing food and the maize group at the other end as fat or heat producing. The wheat group is intermediate between these two.

In the oat group belong the less common cereals, emmer and einkorn, and in the maize group proso and nonsaccharine sorghum.

(3) The two cereals emmer (*Triticum dicoccum*) and einkorn (*Triticum monococcum*) belong to the same group as the oats and like it are characterized by high protein and relatively low carbohydrate. They have a lower intrinsic food value than the other grains, but a narrow nutritive ratio and consequently are muscle or energy producers. In food value they are nearly the same as oats, and their cultivation where oats can not be grown is to be advocated.

(4) The two cereals proso or broom-corn millet (*Panicum miliaceum*) and the nonsaccharine sorghum (*Andropogon sorghum*) belong to the maize group, and though lower in food value than maize itself they equal the oat group. They are of great importance when maize can not be grown and when there is need for a high carbohydrate and heat or fat producing food.

(5) Barley and rye belong to the wheat group and are nearly equal to it in food value.

DETAILED TABULATION OF ANALYTICAL AND CALCULATED RESULTS.

TABLE XXXVIII.—*Oats—individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein. (N × 6.25.)			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
266	Pfiffelbacher's Prolific	295	Germany	Original	9.85	90.15	4.04	12.06	9.41	2.21	5.05	4.19	2.20	10.77	2.80	0.69	68.08	52.42	13.00	18.10	78,246	6.9
267	Giant Thick Head	296	do	do	9.86	90.14	4.27	13.19	10.29	2.42	4.90	4.07	2.14	11.48	2.98	.74	66.17	50.95	12.63	17.93	77,511	6.1
268	Gray Winter	299	do	do	9.52	90.48	4.25	12.94	10.09	3.27	7.03	5.83	3.07	9.33	2.43	.60	66.41	51.15	12.68	18.72	80,926	6.6
269	Pewsammer Hammerich	302	do	do	9.03	90.97	3.84	10.00	7.80	1.83	6.40	5.31	2.79	11.77	3.06	.76	67.99	52.35	12.98	18.36	79,370	8.6
270	Anderbeck	303	do	do	9.34	90.66	3.94	11.44	8.92	2.10	5.77	4.79	2.52	11.18	2.91	.72	67.67	52.10	12.92	18.26	78,938	7.4
271	Bavarian Mountain	304	do	do	9.18	90.82	3.50	10.06	7.85	1.84	5.78	4.80	2.52	12.77	3.32	.82	67.99	52.35	12.98	18.16	78,506	8.5
272	Victoria	305	do	do	9.17	90.83	3.67	10.19	7.95	1.87	6.04	5.01	2.64	11.06	2.88	.71	69.04	53.16	13.16	18.38	79,457	8.5
273	Longfellow	306	do	do	9.80	90.20	3.97	11.87	9.26	2.18	6.04	5.01	2.64	11.41	2.97	.74	66.71	51.36	12.74	18.30	79,111	7.1
274	Danish Island	308	do	do	9.67	90.33	3.87	11.50	8.97	2.11	5.59	4.64	2.44	11.98	2.85	.71	68.06	52.40	12.99	18.25	78,895	7.3
275	Yellow Thuringien	309	do	do	8.97	91.03	4.70	11.19	8.73	2.05	6.14	5.10	2.68	10.64	2.77	.69	67.33	51.84	12.86	18.28	79,024	7.6
276	Milton	310	do	do	9.14	90.86	4.01	11.44	8.92	2.10	5.37	4.46	2.35	10.15	2.64	.65	69.03	53.15	13.18	18.28	79,024	7.4
277	Waterloo	312	do	do	9.23	90.77	3.81	10.06	7.85	1.84	5.68	4.71	2.48	10.86	2.82	.70	69.59	53.58	13.29	18.31	79,154	8.5
278	Yellow Giant	314	do	do	9.52	90.48	4.21	12.56	9.80	2.30	5.69	4.72	2.48	10.15	2.64	.65	67.39	51.89	12.87	18.30	79,111	6.6
279	Yellow Flanders	316	do	do	9.19	90.81	4.12	11.44	8.92	2.10	6.13	5.09	2.68	11.04	2.87	.71	67.27	51.79	12.84	18.33	79,240	7.4
280	Georgian	317	do	do	8.93	91.07	4.06	12.12	9.45	2.22	6.93	5.75	3.02	10.48	2.72	.67	66.41	51.14	12.68	18.59	80,364	7.1
281	White Polish	318	do	do	10.30	89.70	4.40	10.75	8.38	1.97	6.55	5.44	2.86	10.48	2.72	.67	67.82	52.22	12.70	18.20	78,679	8.0
282	Rugen	319	do	do	10.18	89.82	4.12	10.94	8.53	2.00	6.65	5.52	2.90	10.77	2.80	.69	67.52	51.99	12.89	18.48	79,889	7.9
283	Barbachlov	321	do	do	10.34	89.66	4.34	11.87	9.26	2.18	6.34	5.26	2.77	11.10	2.89	.72	66.35	51.09	12.67	18.34	79,284	7.1
284	Podolia	322	do	do	10.51	89.49	4.32	10.94	8.53	2.00	6.10	5.06	2.66	10.36	2.69	.67	63.28	48.73	12.08	17.41	75,263	7.4
285	White Swedish	323	do	do	9.68	90.32	3.94	9.69	7.56	1.78	5.64	4.68	2.46	11.38	2.96	.73	69.35	53.40	13.24	18.21	78,722	8.8
315		288	England	do	7.50	92.50	3.33	12.00	9.36	2.20	5.13	4.26	2.24	11.50	2.99	.74	68.04	52.39	12.99	18.17	78,549	6.9
1229		288	do	do	9.35	90.65	3.19	11.87	9.26	2.18	5.69	4.72	2.48	11.76	3.06	.76	67.49	51.96	12.88	18.30	79,111	7.1
316		289	do	do	7.29	92.71	3.15	11.87	9.26	2.18	7.17	5.95	3.13	8.38	2.18	.54	69.43	53.46	13.26	19.11	82,612	7.4
1230		289	do	do	11.40	88.60	3.02	12.19	9.51	2.23	7.31	6.07	3.19	8.92	2.32	.57	68.56	52.79	13.09	19.08	82,483	7.2
317		290	do	do	6.89	93.11	2.78	9.94	7.75	1.82	4.94	4.10	2.16	11.22	2.92	.72	71.12	54.76	13.58	18.28	79,024	8.6
1231		290	do	do	9.02	90.98	2.68	10.38	8.10	1.90	4.88	4.05	2.13	10.95	2.85	.71	71.11	54.75	13.58	18.32	79,197	8.2
313	Red Algerian	286	do	do	7.12	92.88	4.04	10.56	8.24	1.94	6.00	4.98	2.62	10.59	2.75	.68	68.45	52.70	13.07	18.31	79,154	8.1
314	Yellow Oat	287	do	do	7.14	92.86	3.04	13.31	10.38	2.44	5.58	4.63	2.44	8.61	2.24	.55	69.46	53.48	13.26	18.69	80,797	6.4
318		291	do	do	7.43	92.57	2.64	11.31	8.82	2.07	4.39	3.64	1.91	11.64	3.03	.75	70.02	53.92	13.37	18.10	78,246	7.4
319		292	do	do	7.23	92.77	3.31	11.25	8.77	2.06	5.16	4.28	2.25	10.00	2.60	.64	70.28	54.12	13.42	18.37	79,413	7.6
1225	Gray Winter	265	France	Original	7.37	92.63	3.34	11.81	9.21	2.16	6.63	5.50	2.89	9.60	2.50	.62	68.62	52.84	13.10	18.77	81,143	7.3
301	Yellow Giant	266	do	do	8.08	91.92	3.21	12.44	9.70	2.28	4.98	4.13	2.17	11.64	3.03	.75	67.73	52.15	12.94	18.14	78,419	6.6

302	Black Mesdag	267	do	do	8.07	91.93	3.85	11.31	8.82	2.07	5.73	4.76	2.50	12.96	3.37	.84	66.14	50.93	12.63	18.04	77,987	7.4
303	Black Coulommiers	269	do	do	7.69	92.31	3.41	10.94	8.53	2.00	6.24	5.18	2.72	9.80	2.55	.63	69.61	53.60	13.29	18.64	80,581	7.9
304	Gray Houdon	270	do	do	7.35	92.65	3.68	12.44	9.70	2.28	6.22	5.16	2.71	9.83	2.56	.63	67.83	52.23	12.95	18.57	80,278	6.8
305	Joanette d'Chenailles	271	do	do	7.53	92.47	3.71	12.69	9.90	2.33	5.96	4.95	2.60	11.05	2.87	.71	66.59	51.27	12.71	18.35	79,327	6.6
306	Early Stamp	272	do	do	7.80	92.20	3.44	11.06	8.63	2.03	6.32	5.25	2.76	9.86	2.56	.63	69.31	53.37	13.23	18.65	80,624	7.8
311	Black Brie	279	do	do	8.39	91.61	3.51	10.81	8.43	1.98	5.80	4.81	2.53	9.37	2.44	.60	70.51	54.29	13.46	18.57	80,278	8.0
219	Belgian Winter	166	do	do	6.34	93.66	3.10	12.31	9.60	2.26	7.09	5.88	3.09	9.78	2.54	.63	67.72	52.14	12.93	18.91	81,748	7.1
1222	do	166	do	do	7.96	92.04	2.22	12.25	9.55	2.24	6.64	5.51	2.90	8.45	2.20	.55	70.44	54.24	13.45	19.14	82,742	7.2
224	do	276	do	do	6.99	93.01	3.38	10.13	7.90	1.86	6.65	5.52	2.90	8.45	2.20	.55	71.39	54.97	13.63	18.94	81,878	8.8
1227	do	276	do	do	8.66	91.34	3.44	10.25	7.99	1.88	6.90	5.73	3.01	8.41	2.19	.54	71.00	54.67	13.56	18.99	82,094	8.7
310[a]	Hull-less	278	do	do	7.68	92.32	2.90	22.44	17.50	4.11	5.81	4.82	2.54	3.24	.84	.21	65.61	50.52	12.53	19.39	83,823	3.5
1378[a]	do		do	do	8.40	91.60	2.13	14.31	11.16	2.62	6.71	5.57	2.93	2.36	.61	.15	74.49	57.36	14.22	19.92	86,114	6.3
222	North Finnish Black	254	Finland	do	7.52	92.48	3.87	12.88	10.05	2.36	5.42	4.50	2.37	11.59	3.01	.75	66.24	51.00	12.65	18.13	78,376	6.4
1223	do	167	do	do	7.50	92.50	4.19	11.81	9.21	2.16	5.92	4.91	2.58	10.23	2.66	.66	67.85	52.24	12.95	18.35	79,327	7.2
1224	do	174	do	do	7.24	92.76	3.62	15.81	12.33	2.90	5.07	4.21	2.21	9.84	2.56	.63	65.66	50.56	12.54	18.28	79,024	5.1
1228	do	283	do	do	9.08	90.92	3.35	13.06	10.19	2.39	5.46	4.53	2.38	11.02	2.86	.71	67.11	51.67	12.81	18.29	79,068	6.3
221	Gentile	169			6.42	93.58	4.68	8.56	6.68	1.57	5.74	4.76	2.50	17.50	4.55	1.13	63.52	48.91	12.13	17.33	74,917	9.6
215	Swedish Select	134	Russia	do	7.25	92.75	3.29	12.69	9.90	2.33	5.02	4.17	2.19	13.71	3.56	.88	65.29	50.27	12.46	17.86	77,209	6.4
433	do	134	do	do	5.96	94.04	2.99	12.62	9.84	2.31	4.33	3.59	1.89	9.55	2.48	.61	70.51	54.29	13.46	18.27	78,981	6.6
407	do	213	do	do	6.75	93.25	3.00	11.75	9.17		3.74	3.10	1.63	11.17	2.90	.72	70.29	54.12	13.42			
216	Tobolsk	135	do	do	6.70	93.30	2.85	12.19	8.91	2.23	6.11	5.07	2.67	13.43	3.49	.87	65.42	50.37	12.49	18.26	78,938	6.9
1221	do	135	do	do	7.90	92.10	2.74	12.63	9.85	2.31	6.08	5.05	2.66	12.33	3.21	.80	66.22	50.99	12.64	18.41	79,586	6.6
217	Zhelanni	136	do	do	6.25	93.75	3.63	12.44	9.70	2.28	6.73	5.59	2.94	13.53	3.52	.87	63.67	49.03	12.16	18.25	78,895	6.7
218	Shatilov	144	do	do	6.16	93.84	3.94	12.06	9.41	2.21	5.79	4.81	2.53	13.36	3.47	.86	64.84	49.93	12.38	17.98	77,727	6.8
312[a]	Burt	293	Va	do	7.69	92.31	3.69	13.56	10.58	2.49	7.06	5.86	3.08	11.53	3.00	.74	64.16	49.40	12.25	18.56	80,235	6.2
1232[a]	do	293	do	do	8.78	91.22	3.96	13.44	10.48	2.46	6.86	5.69	2.99	11.92	3.10	.77	63.82	49.14	12.19	18.41	79,586	6.2
1226[a]	Snoma	274	S. Dak	do	10.17	89.83	4.01	16.06	12.53	2.94	7.47	6.20	3.26	9.73	2.53	.63	62.73	48.30	11.98	18.81	81,316	5.2
1233[a]	Applers Rust Proof	339	Ga	do	8.02	91.98	3.06	11.94	9.31	2.19	6.71	5.57	2.93	12.04	3.13	.78	66.15	50.94	12.63	17.53	80,105	7.1
212	Swedish Select	213	Nebr	1903	7.20	92.80	4.58	16.00	12.48	2.93	4.50	3.73	1.96	14.01	3.64	.89	60.91	46.90	11.63	17.41	75,263	4.7
409	do	213	do	1903 (1)	6.65	93.35	4.81	11.37	8.87	2.08	3.64	3.02	1.59	14.55	3.78	.94	65.63	50.54	12.53	17.14	74,096	6.9
410	do	213	do	1903 (1)	6.54	93.46	3.96	12.50	9.75	2.29	3.32	2.76	1.45	12.95	3.37	.84	67.27	51.80	12.85	17.43	75,350	6.3
411	do	213	do	1903 (1)	6.50	93.50	4.39	12.37	9.65	2.27	3.48	2.89	1.52	14.98	3.89	.96	64.78	49.88	12.37	17.12	74,010	6.2
412	do	213	do	1903 (1)	5.95	94.05	4.63	16.00	12.48	2.93	3.80	3.15	1.66	12.80	3.33	.83	62.77	48.33	11.98	17.40	75,220	4.7
413	do	213	do	1903 (1)	5.42	94.58	4.55	14.06	10.97	2.58	4.01	3.33	1.75	13.81	3.59	.89	63.58	48.95	12.14	17.36	75,047	5.5
414	do	213	do		5.30	94.70	4.98	11.56	9.02	2.12	3.37	2.80	1.47	16.78	4.36	1.08	63.31	48.75	12.09	16.76	72,453	6.6
415	do	213	do		5.01	94.99	5.03	12.87	10.04	2.36	3.71	3.08	1.62	15.12	3.93	.97	63.27	48.72	12.08	17.03	73,621	5.9
416	do	213	do		5.97	94.03	4.24	13.75	10.72	2.52	3.73	3.10	1.63	13.21	3.43	.85	65.07	50.10	12.43	17.43	75,350	5.6
1235	do	213	do	1903 (1)	8.44	91.56	4.53	9.13	7.12	1.67	3.60	2.99	1.57	20.08	5.22	1.29	62.66	48.25	11.96	16.49	71,286	8.5
1236	do	213	do	1905 (3)	8.83	91.17	4.64	12.13	9.46	2.22	4.82	4.00	2.10	12.00	3.12	.77	66.41	51.14	12.68	17.77	76,820	6.7
371	do	213	do	1904	7.38	92.62	4.69	10.13	7.90	1.86	3.56	2.95	1.55	17.69	4.60	1.14	63.93	49.22	12.20	16.75	72,410	7.6
373	do	213	do		6.79	93.21	4.12	14.44	11.26	2.65	3.90	3.24	1.70	12.68	3.30	.82	64.86	49.94	12.38	17.55	75,869	5.4
374	do	213	do		6.92	93.08	3.78	11.69	9.12	2.14	3.95	3.28	1.73	13.27	3.45	.86	67.31	51.83	12.86	17.59	76,041	6.9
380	do	213	do	1904	6.65	93.35	4.44	11.00	8.58	2.02	3.86	3.20	1.68	14.81	3.85	.95	65.89	50.74	12.58	17.23	74.485	7.2
385	do	213	do	1904	6.79	93.21	4.35	11.37	8.87	2.08	3.97	3.30	1.74	12.81	3.33	.83	67.50	51.97	12.89	17.54	75,825	7.1
394	do	213	do	1904	6.57	93.43	3.85	11.37	8.87	2.08	3.71	3.08	1.62	13.29	3.46	.86	67.78	52.19	12.94	17.50	75,652	7.0
402	do	213	do	1904	5.99	94.01	3.86	12.75	9.94	2.34	3.16	2.62	1.38	12.58	3.27	.81	66.36	51.10	12.67	17.20	74.356	6.1
408	do	213	do		7.17	92.83	3.99	16.12	12.57	2.95	3.06	2.54	1.34	12.72	3.31	.82	64.66	49.79	12.35	17.46	75,479	4.7
391	do	213	S. Dak		6.43	93.57	4.13	14.94	11.65	2.74	4.34	3.60	1.89	11.20	2.91	.72	65.39	50.35	12.48	17.83	77,079	5.3
436	do	134	do	1902	6.46	93.54	3.57	13.12	10.23	2.40	4.37	3.63	1.91	12.98	3.37	.84	66.00	50.82	12.60	17.75	76,733	6.1
437	do	134	do	1902	6.72	93.28	3.83	11.62	9.06	2.13	3.64	3.02	1.59	12.54	3.26	.81	68.37	52.64	13.05	17.58	75,998	6.9
438	do	134	do	1902	6.46	93.54	3.31	12.56	9.80	2.30	4.09	3.39	1.78	13.11	3.41	.85	66.93	51.53	12.78	17.71	76,590	6.4

[a] Omitted from the average.

TABLE XXXVIII.—*Oats—individual analyses*—Continued.

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein. (N× 6.25.)			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
439	Swedish Select	134	S. Dak.	1902	5.70	94.30	2.94	11.44	8.92	2.10	5.04	4.18	2.20	13.43	3.49	0.87	67.15	51.70	12.82	17.99	77,771	7.2
440	do	134	do	1902	6.05	93.95	3.99	15.31	11.94	2.80	4.60	3.82	2.01	10.93	3.36	.83	65.17	50.18	12.44	18.08	78,160	5.2
441	do	134	do	1902	5.76	94.24	4.19	13.00	10.14	2.38	4.55	3.78	1.99	12.16	3.16	.79	66.10	50.90	12.62	17.78	76,863	6.2
430	do	213	do	1903	5.39	94.61	3.99	12.69	9.90	2.33	3.34	2.77	1.46	12.32	3.20	.79	67.66	52.10	12.92	17.50	75,652	6.2
351	do	134	do	1904	7.23	92.77	4.80	14.12	11.01	2.59	4.78	3.97	2.09	11.55	3.00	.74	64.75	49.86	12.36	17.78	76,863	5.6
353	do	134	do	1904	7.07	92.93	3.87	11.00	8.58	2.02	4.67	3.88	2.04	14.22	3.70	.92	66.24	51.01	12.65	17.63	76,214	7.4
354	do	134	do	......	7.12	92.88	3.95	17.25	13.45	3.16	4.88	4.05	2.13	10.32	2.68	.66	63.60	48.97	12.14	18.09	78,203	4.5
1242	do	213	do	1905 (1)	8.66	91.34	3.97	13.06	10.19	2.39	5.01	4.16	2.19	10.64	2.77	.69	67.32	51.83	12.85	18.12	78,333	6.3
1243	do	213	do	1905 (3)	8.22	91.78	3.62	12.31	9.60	2.26	4.64	3.85	2.03	10.94	2.84	.70	68.49	52.73	13.08	18.07	78,117	6.7
1307	do	213	do	1905	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1308	do	134	do	1905 (5)	8.95	91.05	3.65	11.44	8.92	2.10	4.71	3.91	2.06	13.48	3.50	.87	66.72	51.37	12.74	17.77	76,820	7.1
417	do	213	Iowa	1903	5.98	94.02	3.58	10.44	8.14	1.91	3.67	3.05	1.60	13.25	3.44	.85	69.06	53.17	13.18	17.54	75,825	7.8
418	do	213	do	1903	5.90	94.10	3.89	13.00	10.14	2.38	3.36	2.79	1.47	13.69	3.56	.88	66.06	50.87	12.61	17.34	74,961	6.0
419	do	213	do	1903	5.11	94.89	3.93	12.12	9.45	2.22	3.89	3.23	1.70	15.20	3.95	.98	64.86	49.94	12.38	17.28	74,701	6.5
420	do	213	do	1903	5.00	95.00	5.06	13.37	10.43	2.45	3.76	3.12	1.64	17.47	4.54	1.13	60.34	46.46	11.52	16.74	72,367	5.6
362	do	213	do	1904	5.27	94.73	4.55	9.19	7.17	1.68	3.82	3.17	1.67	12.87	3.35	.83	69.60	53.59	13.29	17.47	75,523	8.9
366	do	213	do	1904	6.09	93.91	4.33	10.56	8.24	1.94	3.41	2.83	1.49	18.70	4.86	1.21	63.00	48.51	12.03	16.67	72,064	7.2
368	do	213	do	1904	6.34	93.66	4.26	12.87	10.04	2.36	3.23	2.68	1.41	13.83	3.60	.89	65.81	50.67	12.56	17.22	74,442	6.0
370	do	213	do	1904	6.27	93.73	3.92	10.81	8.43	1.98	4.19	3.48	1.83	14.14	3.68	.91	66.94	51.54	12.78	17.50	75,652	7.5
382	do	213	do	1904	6.58	93.42	3.83	9.81	7.65	1.80	4.14	3.44	1.81	12.39	3.22	.80	69.83	53.77	13.33	17.74	76,690	8.5
386	do	213	do	1904	6.81	93.19	3.55	10.31	8.04	1.89	3.84	3.19	1.68	13.88	3.61	.90	68.42	52.68	13.06	17.53	75,782	7.9
398	do	213	do	1904	6.35	93.65	3.97	12.50	9.75	2.29	3.82	3.17	1.67	12.51	3.25	.81	67.70	52.13	12.93	17.70	76,517	6.4
1237	do	213	do	1905 (3)	8.89	91.11	3.75	10.44	8.14	1.91	4.18	3.47	1.83	13.96	3.63	.90	67.67	52.10	12.92	17.56	75,912	7.8
1238	do	213	do	1905 (2)	9.42	90.58	3.83	12.37	9.65	2.03	4.43	3.68	1.94	11.20	2.91	.72	68.17	52.49	13.02	17.71	76,560	6.6
1306	do	134	do	1905 (6)	9.51	90.49	3.80	11.75	9.16	2.15	4.41	3.66	1.93	12.30	3.20	.79	67.74	52.16	12.94	17.81	76,993	6.9
422	do	213	Mich.	1903	4.99	95.01	3.68	13.37	10.43	2.45	3.78	3.14	1.65	14.16	3.68	.91	65.01	50.06	12.42	17.43	75,350	5.8
423	do	213	do	1903 (1)	5.38	94.62	3.10	14.62	11.40	2.68	3.38	2.81	1.48	12.68	3.30	.82	66.22	50.99	12.64	17.62	76,171	5.3
424	do	213	do	1903 (1)	5.23	94.77	3.68	14.50	11.31	2.66	3.57	2.96	1.56	12.46	3.24	.80	65.79	50.66	12.56	17.58	75,998	5.7
356	do	213	do	1904	6.69	93.31	3.88	11.19	8.73	2.05	5.21	4.32	2.23	11.64	3.03	.75	68.08	52.42	13.00	18.07	78,117	7.5
360	do	213	do	1904	7.17	92.83	3.54	11.87	9.26	2.18	4.26	3.54	1.86	10.57	2.75	.68	69.76	53.72	13.32	18.04	77,987	7.0
361	do	213	do	1904	6.30	93.70	3.54	12.69	9.90	2.33	4.60	3.82	2.01	10.25	2.66	.66	68.92	53.07	13.16	18.16	78,506	6.5
363	do	213	do	1904	6.09	93.91	3.65	11.81	9.21	2.16	4.11	3.41	1.79	11.52	3.00	.74	68.87	53.03	13.15	17.84	77,122	6.9
364	do	213	do	1904	6.02	93.98	3.73	10.75	8.38	1.97	5.23	4.34	2.28	13.18	3.43	.85	67.11	51.67	12.81	17.91	77,425	7.7
387	do	213	do	1904	6.38	93.62	3.73	10.19	7.95	1.87	3.38	3.22	1.69	14.51	3.71	.92	67.70	52.13	12.93	17.41	75,263	7.9
388	do	213	do	1904	6.88	93.12	3.44	15.56	12.14	2.85	3.91	3.25	1.71	11.60	3.02	.75	65.49	50.42	12.50	17.81	76,993	5.0
1254	do	213	do	1905 (2)	8.39	91.61	3.38	13.06	10.19	2.39	3.10	2.57	1.35	11.05	2.87	.71	69.41	53.44	13.25	17.70	76,517	6.1

1255	do	213	do	1905 (2)	8.56	91.44	3.55	13.87	10.82	2.54	4.46	3.70	1.95	10.63	2.76	.68	67.49	51.96	12.88	18.05	78,030	5.8
1256	do	213	do	1905 (2)	9.46	90.54	3.64	11.82	9.22	2.17	3.51	2.91	1.53	12.50	3.25	.81	68.53	52.76	13.08	17.59	76,041	6.8
1257	do	213	do	1905 (2)	9.22	90.78	3.32	13.00	10.14	2.38	3.02	2.51	1.32	10.95	2.85	.71	69.71	53.67	13.31	17.72	76,603	6.1
1258	do	213	do	1905 (3)	8.63	91.37	3.52	15.75	12.28	2.89	4.24	3.52	1.85	9.79	2.55	.63	66.70	51.36	12.74	18.11	78,289	5.0
1310	do	134	Wis	1903 (5)	8.60	91.40	3.16	12.19	9.51	2.23	4.32	3.59	1.89	9.80	2.55	.63	70.53	54.33	13.47	18.22	78,765	6.8
389	do	134	do		6.46	93.54	3.04	11.44	8.92	2.10	4.12	3.42	1.80	12.70	3.30	.82	68.70	52.89	13.12	17.84	77,122	7.2
390	do	134	do		6.30	93.70	3.76	9.75	7.60	1.79	4.24	3.52	1.85	12.49	3.25	.81	69.76	53.71	13.32	17.77	76,820	8.5
392	do	134	do		6.33	93.67	3.25	12.50	9.75	2.29	4.41	3.66	1.93	11.65	3.03	.75	68.19	52.50	13.02	17.99	77,771	6.5
395	do	134	do		6.54	93.46	3.52	12.19	9.51	2.23	3.68	3.05	1.60	13.46	3.50	.87	67.15	51.71	12.82	17.52	75,739	6.5
397	do	134	do		6.32	93.68	2.96	12.56	9.80	2.30	3.98	3.30	1.74	12.27	3.19	.79	68.23	52.53	13.03	17.86	77,209	6.4
399	do	134	do		5.90	94.10	4.14	8.75	6.82	1.60	4.19	3.48	1.83	14.19	3.69	.91	68.73	52.92	13.12	17.46	75,479	9.4
401	do	134	do		5.87	94.13	3.43	11.06	8.63	2.03	4.56	3.78	1.99	13.28	3.45	.86	67.67	52.10	12.92	17.80	76,949	7.4
403	do	134	do		5.63	94.37	4.60	13.81	10.77	2.53	3.67	3.05	1.60	15.19	3.95	.98	62.73	48.30	11.98	17.09	73,880	5.5
404	do	134	do		6.24	93.76	3.57	10.69	8.34	1.96	4.15	3.44	1.81	11.39	2.96	.73	70.20	54.06	13.40	17.90	77,382	7.8
405	do	134	do		6.47	93.53	3.08	11.94	9.31	2.19	3.87	3.21	1.69	11.51	2.99	.74	69.60	53.59	13.29	17.91	77,425	6.8
1253	do	213	do	1905 (2)	9.39	90.61	3.85	11.06	8.63	2.03	4.09	3.39	1.78	10.29	2.68	.66	70.71	54.45	13.50	17.97	77,684	7.5
434	do	134	Mont	1902 (1)	6.09	93.91	3.94	12.75	9.94	2.34	5.28	4.38	2.30	9.16	2.38	.59	68.87	53.03	13.15	18.38	79,457	6.6
435	do	134	do	1902 (1)	6.95	93.05	4.23	13.56	10.58	2.49	4.15	3.44	1.81	9.76	2.54	.63	68.30	52.59	13.04	17.97	77,684	5.9
355	do	134	do	1903	7.20	92.80	4.00	13.75	10.73	2.52	4.53	3.76	1.98	9.11	2.37	.59	68.61	52.83	13.10	18.19	78,635	5.9
352	do	134	do	1904	6.42	93.58	3.79	12.50	9.75	2.29	5.60	4.65	2.45	9.27	2.41	.60	68.85	53.01	13.15	18.49	79,932	6.7
393	do		do		6.51	93.49	3.89	14.25	11.11	2.61	4.70	3.90	2.05	10.43	2.71	.67	66.73	51.38	12.74	18.07	78,117	5.7
396	do		do	1904	6.62	93.38	4.69	15.00	11.70	2.75	3.87	3.21	1.69	9.81	2.55	.63	66.63	51.31	12.72	17.79	76,906	5.2
421	do	213	Kans	1903	5.23	94.78	4.61	14.69	11.46	2.69	3.82	3.17	1.67	12.77	3.32	.82	64.11	49.36	12.24	17.42	75,307	5.2
357	do	213	do	1904	6.74	93.26	4.45	15.12	11.79	2.77	4.34	3.60	1.89	13.10	3.41	.85	62.99	48.50	12.03	17.54	75,825	5.1
372	do	213	do		6.69	93.31	4.71	14.94	11.65	2.74	3.75	3.11	1.64	11.19	2.91	.72	64.61	49.75	12.34	17.44	75,393	5.1
375	do	213	do		6.95	93.05	4.64	13.50	10.53	2.47	3.72	3.09	1.63	13.34	3.47	.86	64.80	49.89	12.37	17.33	74,917	5.7
384	do	213	do		6.64	93.36	4.01	12.94	10.09	2.37	3.84	3.19	1.68	12.32	3.20	.79	66.89	51.50	12.77	17.61	76,128	6.1
1234	do	213	do	1905 (3)	9.15	90.85	4.08	15.56	12.14	2.85	4.23	3.51	1.85	10.00	2.60	.64	66.13	50.92	12.63	17.97	77,684	5.0
379	do	213	Wash		7.18	92.82	4.28	13.31	10.38	2.44	4.51	3.74	1.97	10.57	2.75	.68	67.33	51.84	12.86	17.95	77.598	6.1
428	do	213	do	1903 (1)	6.62	93.38	4.04	14.75	11.50	2.70	3.67	3.05	1.60	9.38	2.44	.60	68.16	52.48	13.01	17.91	77,425	5.4
429	do	213	do	1903 (1)	6.38	93.62	3.41	11.44	8.92	2.10	3.98	3.30	1.74	9.61	2.50	.62	71.56	55.10	13.66	18.12	78,333	7.3
1247	do	213	do	1904 (2)	7.37	92.63	3.44	11.38	8.88	2.09	5.27	4.37	2.30	9.96	2.59	.64	69.95	53.86	13.36	18.39	79,500	7.5
1248	do	213	do	1905 (3)	9.34	90.66	3.75	12.44	9.70	2.28	4.80	3.98	2.09	10.94	2.84	.70	68.07	52.41	13.00	18.07	78,117	6.6
431	do	213	N. Y	1903	5.63	94.37	3.43	12.19	9.51	2.23	3.09	2.56	1.35	12.13	3.15	.78	69.16	53.25	13.21	17.57	75,955	6.5
367	do	213	do	1904	6.48	93.52	3.39	14.69	11.46	2.69	4.05	3.36	1.77	10.37	2.70	.67	67.50	51.97	12.89	18.02	77,900	5.4
383	do	213	do		6.54	93.46	3.20	14.25	11.11	2.61	3.78	3.14	1.65	11.55	3.00	.74	67.22	51.76	12.84	17.84	77,122	5.6
1261	do	213	do	1904 (2)	8.02	91.98	3.70	11.44	8.92	2.10	3.88	3.22	1.69	12.88	3.35	.83	68.10	52.43	13.00	17.62	76,171	7.1
1262	do	213	do	1905 (3)	9.79	90.21	3.25	12.50	9.75	2.29	2.88	2.39	1.26	8.46	2.20	.55	72.91	56.14	13.92	18.02	77,900	6.5
425	do	213	Ill	1903	5.60	94.40	3.33	15.50	12.09	2.84	2.88	2.39	1.26	10.57	2.75	.68	67.72	52.14	12.93	17.71	76,560	5.0
426	do	213	do	1903	6.71	93.29	4.41	14.37	11.21	2.63	3.11	2.58	1.36	13.96	3.63	.90	64.15	49.39	12.25	17.14	74,096	5.2
378	do	213	do	1904	6.82	93.18	3.57	13.88	10.83	2.54	3.94	3.27	1.72	11.64	3.03	.75	66.97	51.57	12.79	17.80	76,949	5.7
1264	do	213	do	1905 (3)	9.20	90.80	3.80	14.00	10.92	2.57	3.40	2.82	1.48	10.98	2.85	.71	67.82	52.22	12.95	17.71	76,560	5.6
358	do	213	Penn	1904	6.76	93.24	3.12	12.81	9.99	2.35	4.01	3.33	1.75	11.17	2.90	.72	68.89	53.04	13.15	17.97	77,684	6.3
359	do	213	do	1904	6.73	93.27	2.91	13.25	10.33	2.43	4.61	3.83	2.01	12.07	3.14	.78	67.16	51.71	12.82	18.04	77,987	6.1
1259	do	213	do	1905	8.68	91.32	3.49	15.81	12.33	2.90	3.64	3.02	1.59	10.48	2.72	.67	66.58	51.27	12.71	17.87	77,252	4.9
1260	do	213	do	1905	9.26	90.74	3.24	12.44	9.70	2.28	4.36	3.62	1.90	11.52	2.99	.74	68.44	52.69	13.07	17.99	77,771	6.6
381	do	213	Colo		6.50	93.50	4.42	17.19	13.41	3.15	3.60	2.99	1.57	11.56	3.01	.75	63.23	48.69	12.07	17.54	75,825	4.4
1250	do	213	do	1905 (1)	9.22	90.78	4.52	17.63	13.75	3.23	4.09	3.39	1.78	10.15	2.64	.65	63.61	48.98	12.15	17.81	76,993	4.3
1251	do	213	do	1905 (3)	8.61	91.39	4.29	12.94	10.09	2.37	3.14	2.61	1.37	11.82	3.07	.76	67.81	52.21	12.95	17.45	75,436	6.1
1252	do	213	do	1905 (1)	9.00	91.00	4.60	11.19	8.73	2.29	4.34	3.60	1.89	11.03	2.87	.71	68.84	53.00	13.14	18.03	77,944	7.3
432	do	213	N. C	1903	5.53	94.47	4.46	14.81	11.55	2.71	2.72	2.26	1.19	14.73	3.83	.95	63.28	48.73	12.08	16.93	73,188	5.0
376	do	213	do	1904	6.84	93.16	3.79	11.19	8.73	2.05	4.69	3.89	2.05	11.83	3.08	.76	68.50	52.74	13.08	17.94	77,555	7.4

TABLE XXXVIII.—*Oats—individual analyses*—Continued.

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N×6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1267	Swedish Select	213	N. C	1905 (3)	8.97	91.03	3.85	11.88	9.27	2.18	2.83	2.35	1.24	12.40	3.22	0.80	69.04	53.16	13.18	17.40	75,220	6.6
427	do	213	Ind	1903 (1)	6.22	93.78	3.39	12.69	9.90	2.33	3.39	2.81	1.48	12.06	3.14	.78	68.47	52.72	13.07	17.66	76,344	6.3
1265	do	213	do	1904 (1)	8.48	91.52	3.43	13.38	10.43	2.45	3.22	2.67	1.40	11.68	3.04	.75	68.29	52.58	13.04	17.64	76,258	5.9
1266	do	213	do	1905 (1)	9.05	90.95	3.87	14.19	11.07	2.60	2.87	2.38	1.25	10.96	2.85	.71	68.11	52.44	13.00	17.56	75,912	5.5
406	do	213	Idaho	1904	7.16	92.84	4.57	10.69	8.34	1.96	3.72	3.09	1.63	9.98	2.59	.64	71.04	54.70	13.56	17.79	76,906	7.7
1244	do	213	do	1905 (1)	7.97	92.03	4.79	13.31	10.38	2.44	4.87	4.04	2.13	9.87	2.57	.64	67.16	51.71	12.82	18.03	77.944	6.1
1245	do	213	do	1905 (1)	8.14	91.86	4.35	11.50	8.97	2.11	5.25	4.36	2.29	9.92	2.58	.64	68.98	53.11	13.17	18.21	78,722	7.3
369	do	213	Tex	1904	6.46	93.54	4.09	14.44	11.26	2.65	2.79	2.32	1.22	10.56	2.75	.68	68.12	52.45	13.01	17.56	75,912	5.4
1246	do	213	do	1905 (2)	8.71	91.29	4.22	15.31	11.94	2.81	3.85	3.20	1.68	13.27	3.45	.86	63.35	48.78	12.09	17.44	75,393	5.0
377	do	213	Mo		6.86	93.14	4.36	11.94	9.31	2.19	3.54	2.94	1.55	15.95	4.15	1.03	64,21	49.44	12.26	17.03	73,621	6.5
1249	do	213	do	1903 (1)	10.72	89.28	4.59	11.69	9.12	2.14	1.79	1.48	.78	15.74	4.09	1.01	60.61	46.67	11.57	15.50	67,006	5.9
1239	do	213	N. Dak	1905 (1)	9.75	90.25	3.53	12.00	9.36	2.20	4.91	4.08	2.15	10.32	2.68	.66	70.24	54.08	13.42	18.43	79,673	7.0
1240	do	213	do	1905 (3)	9.20	90.80	3.62	12.94	10.09	2.37	5.20	4.32	2.27	9.36	2.43	.60	68.88	53.04	13.15	18.39	79,500	6.5
1263	do	213	Ohio	1905 (1)	9.64	90.36	3.20	15.06	11.75	2.76	2.62	2.17	1.14	9.53	2.48	.61	69.59	53.59	13.29	17.80	76,949	5.2
1309	do	134	Wyo	1905 (4)	9.35	90.65	3.53	13.50	10.53	2.47	4.71	3.91	2.06	12.09	3.14	.78	66.17	50.95	12.63	17.94	77,555	6.0
365	do	213	Me		6.52	93.48	2.89	12.81	9.99	2.35	4.78	3.97	2.09	10.35	2.69	.67	69.17	53.26	13.21	18.32	79,197	6.5
400	do	213	Canada		6.19	93.81	3.56	13.81	10.77	2.53	3.91	3.25	1.71	11.02	2.86	.71	67.70	52.13	12.93	17.88	77,295	5.8
1241	do	213	do	1905 (2)	8.23	91.77	3.13	13.75	10.72	2.52	4.57	3.79	1.99	9.68	2.52	.62	68.87	53.03	13.15	18.28	79,024	6.0
1268	Sixty Day	165	Kans	1905 (3)	9.06	90.94	4.49	13.87	10.82	2.54	2.09	1.73	.91	11.47	2.98	.74	68.08	52.42	13.01	17.20	74,356	5.5
1269	do	165	Nebr	1905 (1)	8.55	91.45	4.62	15.19	11.85	2.78	2.97	2.47	1.30	10.31	2.68	.66	66.91	51.52	12.78	17.52	75.739	5.0
225	do	165	N. Dak	1903	6.56	93.44	4.56	15.44	12.04	2.83	4.43	3.68	1.94	10.88	2.83	.70	64.69	49.81	12.35	17.82	77.036	5.9
1270	do	165	do	1903 (3)	9.26	90.74	4.56	15.56	12.14	2.85	3.44	2.86	1.50	10.52	2.74	.68	65.92	50.76	12.59	17.62	76.171	4.9
1271	do	165	do	1905 (1)	9.09	90.91	3.79	13.50	10.53	2.47	4.58	3.80	2.00	9.69	2.52	.62	68.44	52.70	13.07	18.16	78,506	6.1
1272	do	165	do	1905 (1)	8.60	91.40	3.45	14.63	11.41	2.68	4.57	3.79	1.99	9.31	2.42	.60	68.04	52.39	12.99	18.26	78,938	5.5
1273	do	165	S. Dak	1902 (2)	9.40	90.60	3.60	17.75	13.84	3.25	3.75	3.11	1.64	10.99	2.86	.71	63.91	49.21	12.20	17.80	76,949	4.3
1274	do	165	do	1902 (2)	8.96	91.04	3.47	19.38	15.12	3.55	3.94	3.27	1.72	10.06	2.62	.65	63.15	48.63	12.06	17.98	77,727	3.9
1275	do	165	do	1903 (3)	9.18	90.82	3.50	14.31	11.16	2.62	4.02	3.34	1.76	11.07	2.88	.71	67.10	51.67	12.81	17.90	77,382	5.6
1276	do	165	do	1904 (4)	9.12	90.88	3.63	14.63	11.41	2.68	3.93	3.26	1.71	10.90	2.83	.70	66.91	51.52	12.78	17.87	77,252	5.4
1277	do	165	do	1905 (4)	8.88	91.12	3.53	12.00	9.36	2.20	3.89	3.23	1.70	12.02	3.13	.78	68.56	52.79	13.09	17.77	76,820	6.7
1278	do	165	do	1905 (5)	9.49	90.51	3.61	15.88	12.39	2.91	3.77	3.13	1.65	10.43	2.71	.67	66.31	51.06	12.66	17.89	77,338	4.9
1279	do	165	do	1903 (3)	9.06	90.94	4.13	16.44	12.82	3.01	4.10	3.40	1.79	9.83	2.56	.63	65.50	50.43	12.51	17.94	77,555	4.7
1280	do	165	do	1904 (4)	8.51	91.49	3.74	18.69	14.58	3.43	4.70	3.90	2.05	9.30	2.42	.60	63.57	48.95	12.14	18.22	78,765	4.1
1281	do	165	do	1905 (5)	8.91	91.09	4.08	16.25	12.67	2.98	3.72	3.09	1.63	9.77	2.54	.63	66.18	50.96	12.64	17.88	77,295	4.8
1282	do	165	do	1905 (7)	8.92	91.08	3.99	13.56	10.58	2.49	4.36	3.62	1.90	10.36	2.69	.67	67.73	52.15	12.94	18.00	77,814	6.0
1283	do	165	do	1903 (2)	8.63	91.37	3.81	11.50	8.97	2.11	5.65	4.69	2.47	11.08	2.88	.71	67.96	52.33	12.98	18.27	78,981	7.3
1284	do	165	do	1904 (3)	8.61	91.39	3.74	10.87	8.48	1.99	5.59	4.64	2.44	12.94	3.36	.83	66.86	51.48	12.77	18.03	77,944	7.7

1285	.....do	165	...do	1902 (1)	9.43	90.57	3.93	15.94	12.43	2.92	3.59	2.98	1.57	10.82	2.81	.70	65.72	50.61	12.55	17.74	76,690	4.8
1286	.....do	165	...do	1904 (3)	9.57	90.43	3.67	12.31	9.60	2.26	4.51	3.74	1.97	10.32	2.68	.66	69.19	53.27	13.21	18.10	78,246	6.7
1287	.....do	165	Wash	1905 (1)	9.02	90.98	4.09	16.81	13.11	3.08	4.83	4.01	2.11	9.08	2.36	.58	65.19	50.20	12.45	18.22	78,765	4.7
1288	.....do	165	Tex	1905 (2)	8.79	91.21	4.14	15.75	12.28	2.89	3.20	2.66	1.40	12.03	3.13	.78	64.88	49.96	12.39	17.46	75,479	4.8
1289	.....do	165	Idaho	1905 (1)	8.73	91.27	4.58	11.06	8.63	2.03	4.33	3.59	1.89	10.94	2.84	.70	69.09	53.19	13.19	17.81	76,993	7.4
1290	.....do	165	Wyo	1905 (1)	8.81	91.19	3.81	13.87	10.82	2.54	4.43	3.68	1.94	8.85	2.30	.57	69.04	53.16	13.18	18.23	78,808	5.9
1291	.....do	165	Colo	1905 (1)	8.23	91.77	4.70	12.94	10.09	2.37	4.10	3.40	1.79	13.67	3.55	.88	64.59	49.73	12.33	17.37	75,090	6.0
1292	.....do	165	...do	1905 (1)	8.62	91.38	5.16	16.25	12.67	2.98	3.81	3.16	1.66	11.28	2.93	.73	63.50	48.89	12.12	17.49	75,609	4.6
1293	.....do	165	Cal	1905 (1)	8.38	91.62	4.41	9.19	7.17	1.68	4.01	3.33	1.75	13.71	3.56	.88	68.68	52.88	13.11	17.42	75,307	8.9
1294	.....do	165	Oreg	1905 (1)	8.54	91.46	4.31	14.44	11.26	2.65	3.85	3.20	1.68	10.27	2.67	.66	67.13	51.69	12.82	17.81	76,993	5.5
1295	.....do	165	...do	1905 (1)	7.73	92.27	5.44	15.25	11.89	2.79	3.21	2.66	1.40	12.55	3.26	.81	63.55	48.93	12.13	17.13	74,053	4.9
1296	.....do	165	Utah	1905 (1)	8.57	91.43	3.70	18.19	14.19	3.33	3.74	3.10	1.63	10.92	2.84	.70	63.45	48.85	12.11	17.77	76,820	4.1
1297	.....do	165	Ohio	1905 (1)	8.34	91.66	3.01	19.75	15.40	3.62	3.22	2.67	1.40	11.67	3.03	.75	62.35	48.01	11.90	17.67	76,387	3.7
1298	.....do	165	...do	1905 (1)	9.81	90.19	3.73	13.13	10.24	2.41	3.65	3.03	1.59	12.21	3.17	.79	67.28	51.80	12.85	17.64	76,258	6.0
1299	.....do	165	N. Y	1905 (1)	8.88	91.12	3.19	12.81	9.99	2.35	3.81	3.16	1.66	11.25	2.92	.72	68.94	53.08	13.16	17.89	77,338	6.3
1300	.....do	165	Ill	1905 (1)	9.02	90.98	3.63	14.44	11.26	2.65	3.53	2.93	1.54	11.33	2.95	.73	70.07	53.95	13.38	18.30	79,111	5.6
1301	.....do	165	Minn	1905 (1)	9.29	90.71	3.85	16.44	12.82	3.01	3.53	2.93	1.54	9.45	2.46	.61	66.73	51.38	12.74	17.90	77,382	4.7
1302	.....do	165	S. C	1905 (1)	8.95	91.05	3.41	13.44	10.48	2.46	4.01	3.33	1.75	11.25	2.92	.72	67.89	52.27	12.96	17.89	77,338	6.0
1303	.....do	165	Md	1904 (2)	8.97	91.03	3.32	13.00	10.14	2.38	3.21	2.66	1.40	12.25	3.18	.79	68.22	52.52	13.02	17.59	76,041	6.1
1304	.....do	165	...do	1904 (1)	10.63	89.37	3.61	12.94	10.09	2.37	3.05	2.53	1.33	12.05	3.13	.78	68.35	52.63	13.05	17.53	75,782	6.1
1305	.....do	165	...do	1905 (2)	10.07	89.93	3.50	15.69	12.24	2.88	2.80	2.32	1.22	12.18	3.17	.79	65.83	50.69	12.57	17.46	75,479	4.8
1311	Tobolsk	135	Kans	1905 (3)	9.32	90.68	3.33	16.06	12.53	2.94	4.63	3.84	2.02	11.55	3.00	.74	64.43	49.61	12.30	18.00	77,814	4.9
1312	.....do	135	N. Dak	1903.(5)	9.37	90.63	3.75	13.63	10.63	2.50	4.81	3.99	2.10	12.13	3.15	78	65.68	50.57	12.54	17.92	77,468	5.9
1313	.....do	135	S. Dak	1902 (2)	8.86	91.14	3.22	14.94	11.65	2.74	4.82	4.00	2.10	14.81	3.85	.95	62.21	47.90	11.88	17.67	76.387	5.2
1314	.....do	135	...do	1904 (6)	7.86	92.14	3.47	10.31	8.04	1.89	4.82	4.00	2.10	17.42	4.53	1.13	63.98	49.26	12.21	17.33	74.917	7.8
1315	.....do	135	...do	1905 (7)	8.11	91.89	3.11	12.44	9.70	2.28	5.29	4.39	2.31	14.54	3.78	.94	64.62	49.76	12.34	17.87	77,252	6.5
1316	.....do	135	...do	1902 (2)	8.25	91.75	3.34	14.25	11.11	2.61	4.28	3.55	1.87	11.05	2.87	.71	67.08	51.65	12.81	18.00	77,814	5.6
1317	.....do	135	...do	1904 (4)	7.55	92.45	3.66	11.82	9.22	2.17	4.68	3.88	2.04	12.40	3.22	.80	67.44	51.93	12.88	17.89	77,338	6.9
1318	.....do	135	...do	1905 (7)	9.02	90.98	3,21	14.13	11.02	2.59	5.05	4.19	2.20	11.56	3.01	.75	66.05	50.86	12.61	18.15	78,462	5.7
1319	.....do	135	...do	1904 (4)	8.44	91.56	3.20	9.19	7.17	1.68	5.81	4.82	2.54	15.43	4.01	1.00	66.37	51.10	12.67	17.89	77,338	9.2
1320	Shatilov	144	...do	1904 (2)	8.84	91.16	4.46	9.75	7.60	1.79	4.15	3.44	1.81	19.82	5.15	1.28	61.82	47.60	11.80	16.68	72,108	7.9
1321	.....do	144	...do	1905 (3)	9.14	90.86	4.33	13.81	10.77	2.53	4.12	3.42	1.80	18.68	4.86	1.21	59.06	45.48	11.28	16.82	72,713	5.4
220	Belgian Winter	166	Cal	1903	6.77	93.23	4.17	9.31	7.26	1.71	5.75	4.77	2.51	12.99	3.38	.84	67.78	52.19	12.94	18.00	77,814	9.1
1322	.....do	166	...do	1903 (1)	8.79	91.21	5.00	13.37	10.43	2.45	6.01	4.99	2.62	11.22	2.92	.72	64.40	49.59	12.30	18.09	78,203	6.1
1323	.....do	166	Ark	1903 (1)	9.21	90.79	4.71	10.00	7.80	1.83	4.31	3.58	1.88	16.97	4.41	1.10	64.01	49.29	12.22	17.03	73,621	7.9
1344	.....do	276	Cal	1905 (1)	7.94	92.06	5.32	12.56	9.80	2.30	5.06	4.20	2.21	13.59	3.53	.88	63.41	48.82	12.11	17.50	75,652	6.3
1324	North Finnish Black	167	S. Dak	1904 (2)	9.19	90.81	4.36	10.31	8.04	1.89	3.09	2.56	1.35	16.23	4.22	1.05	66.01	50.83	12.60	16.89	73,015	7.6
1325	.....do	167	...do	1905 (3)	8.90	91.10	3.97	11.50	8.97	2.11	3.90	3.24	1.70	20.07	5.22	1.30	60.56	46.63	11.56	16.67	72,064	6.6
1330	.....do	174	...do	1903 (2)	9.79	90.21	4.86	14.75	11.50	2.70	4.19	3.48	1.83	13.00	3.38	.84	63.20	48.66	12.07	17.44	75,393	5.2
1331	.....do	174	...do	1905 (4)	9.34	90.66	3.84	11.88	9.27	2.18	3.87	3.21	1.69	13.83	3.59	.89	66.58	51.27	12.71	17.47	75,523	6.7
1332	.....do	174	...do	1905 (3)	9.44	90.56	3.14	9.88	7.71	1.81	3.98	3.30	1.74	15.59	4.05	1.00	67.41	51.90	12.87	17.42	75,307	8.2
1333	.....do	283	N. Dak	1903	9.37	90.63	3.99	10.87	8.48	1.99	5.13	4.26	2.24	11.24	2.92	.72	68.77	52.95	13.13	18.08	78,160	7.7
1334	.....do	254	Tex	1905 (2)	8.69	91.31	3.92	13.81	10.77	2.53	4.34	3.60	1.89	12.63	3.28	.81	65.30	50.28	12.47	17.70	76,517	5.7
1335	.....do	254	Cal	1903 (1)	8.49	91.51	4.02	11.25	8.77	2.05	6.81	5.65	2.97	10.24	2.66	.66	67.68	52.11	12.93	18.61	80,451	7.7
223	.....do	254	...do	1903	6.79	93.21	4.37	11.25	8.77	2.05	6.95	5.77	3.04	11.12	2.89	.72	66.31	51.06	12.67	18.47	79,846	7.6
1336	.....do	254	Colo	1903 (1)	8.76	91.24	3.86	12.69	9.90	2.33	5.38	4.47	2.35	11.84	3.08	.76	66.23	51.00	12.65	18.09	78,203	6.5
1337	.....do	254	...do	1904 (2)	8.15	91.85	3.81	15.38	11.99	2.82	5.28	4.38	2.30	11.24	2.92	.72	64.29	49.50	12.28	18.12	78,333	5.2
1338	.....do	254	...do	1905 (3)	8.22	91.78	3.90	11.69	9.12	2.14	5.82	4.83	2.54	12.86	3.34	.83	65.73	50.61	12.55	18.06	78,073	7.1
1326	Perm	170	Kans	1905 (4)	9.94	90.06	3.93	15.94	12.43	2.92	3.21	2.66	1.40	11.46	2.98	.74	65.46	50.40	12.50	17.56	75,912	4.8
1327	Crown Red	171	...do	1905 (4)	8.97	91.03	4.20	14.88	11.61	2.73	4.53	3.76	1.98	11.20	2.91	.72	65.19	50.20	12.45	17.88	77,295	5.3
1328	.....do	171	S. Dak	1904 (2)	8.54	91.46	5.01	11.00	8.58	2.02	4.44	3.69	1.94	18.54	4.82	1.20	61.01	46.98	11.65	16.81	72,670	7.0
1329	.....do	171	....	1905 (3)	8.64	91.36	4.71	13.87	10.82	2.54	4.02	3.34	1.76	17.70	4.60	1.14	59.70	45.97	11.40	16.84	72,799	5.4

TABLE XXXVIII.—*Oats—individual analyses*—Continued.

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein. (N× 6.25.)			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1339	Kherson	212	Nebr.	1904	8.58	91.42	3.93	12.13	9.46	2.22	3.98	3.30	1.74	12.67	3.29	0.82	67.29	51.81	10.37	15.15	65,493	6.6
1340	Red Rust Proof	256	Kans.	1905 (3)	8.19	91.81	3.43	14.44	11.26	2.65	5.33	4.42	2.33	10.38	2.70	.67	66.42	51.14	12.68	18.33	79,240	5.7
1368	Texas Red Rust Proof	451	...do.	1905 (1)	8.35	91.65	3.93	15.00	11.70	2.75	4.96	4.12	2.17	11.29	2.94	.73	64.82	49.92	12.38	18.03	77,944	5.3
226	.....do.	451			7.02	92.98	3.75	13.44	10.48	2.46	5.52	4.58	2.41	12.66	3.29	.82	64.63	49.76	12.34	18.03	77,944	5.6
1369	.....do.	458	Kans.	1904 (1)	7.72	92.28	4.60	10.31	8.04	1.89	5.40	4.48	2.36	14.18	3.69	.92	65.51	50.44	12.51	17.68	76,431	7.4
1370	.....do.	458	Tex.	1905 (2)	7.86	92.14	4.07	14.81	11.55	2.71	5.71	4.74	2.49	11.31	2.94	.73	64.10	49.36	12.24	18.17	78,549	5.4
1371	.....do.	458	N. C.	1904 (1)	7.69	92.31	3.15	15.19	11.85	2.78	5.71	4.74	2.49	11.58	3.01	.75	64.37	49.56	12.29	18.31	79,154	5.3
1341	Appler's Rust Proof	339	Cal.	1905 (1)	8.18	91.82	3.96	12.38	9.66	2.27	5.78	4.80	2.52	10.17	2.64	.65	67.71	52.14	12.94	18.38	79,457	6.8
320	.....do.	339			6.94	93.06	3.12	11.00	8.58	2.02	6.44	5.35	2.81	11.26	2.93	.73	68.18	52.50	13.02	18.58	80,321	7.9
1376	Culberson Winter	273	Md.	1906	8.84	91.16	2.85	15.37	11.99	2.82	6.54	5.43	2.86	10.64	2.77	.69	64.60	49.74	12.33	18.70	80,840	5.4
1342	.....do.	273	Tex.	1904 (1)	7.67	92.33	4.15	12.75	9.94	2.34	5.99	4.97	2.61	12.53	3 26	.81	64.58	49.73	12.33	18.09	78,203	6.4
1343	.....do.	273	Ill.	1903 (1)	8.67	91.33	3.94	9.94	7.75	1.82	5.46	4.53	2.38	13.51	3.51	.87	67.15	51.70	12.82	17.89	77,338	8.4
1372	.....do.	273	Md.	1904 (1)	9.22	90.78	3.02	13.06	10.19	2.39	6.75	5.60	2.95	10.57	2.75	.68	66.60	51.28	12.72	18.74	81,013	6.5
1373	.....do.	273	...do.	1905 (2)	9.30	90.70	3.84	12.56	9.80	2.30	6.33	5.25	2.76	11.39	2.96	.73	65.88	50.73	12.58	18.37	79,413	6.7
1345	Prince Edward's Island	219	Kans.	1905 (3)	8.66	91.34	4.05	17.38	13.56	3.19	6.23	5.17	2.72	10.11	2.63	.65	62.23	47.92	11.88	18.44	79,716	4.6
1346	Red Algerian	286	...do.	1905 (2)	8.64	91.36	4.87	13.69	10.68	2.51	5.75	4.77	2.51	11.81	3.07	.76	63.88	49.19	12.20	17.98	77,727	5.9
1347	.....do.	286	N. Dak.	1905 (2)	8.56	91.44	4.08	15.06	11.75	2.76	5.82	4.83	2.54	10.92	2.84	.70	64.12	49.37	12.24	18.24	78,851	5.4
1348	.....do.	286	S. Dak.	1905 (2)	9.09	90.91	3.94	12.19	9.51	2.23	5.04	4.18	2.20	14.19	3.69	.92	64.62	49.76	12.34	17.69	76,474	6.6
1349	.....do.	286	...do.	1905 (2)	8.86	91.14	4.67	13.37	10.43	2.45	4.85	4.03	2.12	11.78	3.06	.76	65.33	50.30	12.47	17.80	76,949	6.0
1350	.....do.	286	Tex.	1905 (1)	8.65	91.35	4.05	14.25	11.11	2.61	4.52	3.75	1.97	12.99	3.38	.84	64.19	49.43	12.26	17.68	76,431	5.5
1351	.....do.	286	Cal.	1905 (1)	8.76	91.24	5.27	11.25	8.77	2.07	4.56	3.78	1.99	13.27	3.45	.86	65.65	50.55	12.54	17.46	75,479	7.1
1352	.....do.	286	Oreg.	1905 (1)	8.55	91.45	6.25	16.19	12.63	2.97	4.77	3.96	2.08	9.52	2.48	.61	63.27	48.72	12.08	17.74	76,690	4.8
1353	.....do.	286	Utah	1904 (1)	7.99	92.01	5.34	13.81	10.77	2.53	5.01	4.16	2.19	12.92	3.36	.83	62.92	48.45	12.01	17.56	75,912	5.7
1354	.....do.	286	Ariz.	1905 (1)	8.29	91.71	4.91	11.75	9.16	2.15	5.30	4.40	2.31	13.17	3.42	.85	64.87	49.95	12.39	17.70	76,517	6.9
1379	.....do.	286			8.67	91.33	4.02	10.31	8.04	1.89	6.38	5.30	2.79	11.93	3.10	.77	67.36	51.88	12.87	18.32	79,197	8.3
1355	Unnamed varieties	288	Wash.	1905 (2)	7.80	92.20	4.82	10.94	8.53	2.00	5.87	4.87	2.56	13.73	3.57	.89	64.64	49.77	12.34	17.79	76,906	7.5
1356	.....do	289	...do.	1905 (2)	8.41	91.59	4.43	13.56	10.58	2.49	6.22	5.16	2.71	10.02	2.61	.65	65.77	50.64	12.56	18.41	79,586	6.1
1357	.....do	290	...do.	1905 (2)	8.24	91.76	3.71	12.81	9.99	2.35	4.11	3.41	1.79	11.39	2.96	.73	67.98	52.34	12.98	17.85	77,165	6.3
1358	.....do	291	...do.	1905 (2)	8.02	91.98	3.89	11.44	8.92	2.10	3.70	3.07	1.61	14.57	3.78	.94	66.40	51.13	12.68	17.33	74,917	6.9
1359	.....do	291	Cal.	1905 (1)	8.54	91.46	4.00	12.94	10.09	2.37	3.84	3.19	1.68	13.92	3.62	.90	65.30	50.28	12.47	17.42	75,307	6.1
1360	Burt	293	Kans.	1905 (2)	8.81	91.19	5.10	14.00	10.92	2.57	6.95	5.77	3.04	11.70	3.04	.75	62.25	47.93	11.88	18.24	78,851	5.8
1361	.....do.	293	...do.	1904 (1)	8.26	91.74	5.32	12.81	9.99	2.35	6.65	5.52	2.90	11.38	2.96	.73	63.84	49.16	12.19	18.17	78,549	6.4
1362	.....do.	293	N. Dak.	1905 (2)	8.38	91.62	4.59	15.69	12.24	2.88	6.57	5.45	2.87	10.16	2.64	.65	62.99	48.50	12.03	18.43	79,673	5.2
1363	.....do.	293	Tex.	1904 (1)	7.93	92.07	4.45	13.56	10.58	2.49	5.93	4.92	2.59	12.63	3.28	.81	63.43	48.84	12.12	18.01	77,857	6.0
1364	.....do.	293	...do.	1905 (2)	7.95	9 .05	4.20	15.19	11.85	2.78	6.12	5.08	2.67	12.19	3.17	.79	62.30	47.97	11.89	18.13	78,376	5.3
1365	.....do.	293	Md.	1904 (1)	9.08	90.92	3.81	13.50	10.53	2.47	5.60	4.65	2.45	11.22	2.92	.72	65.87	50.72	12.58	18.22	78,765	6.1

1366	.....do	293	...do	1905 (2)	9.49	90.51	3.14	15.63	12.19	2.86	5.63	4.67	2.46	10.56	2.75	.68	65.04	50.08	12.42	18.42	79,630	5.2
1367	Belyak	336	Cal	1905 (1)	8.42	91.58	4.16	12.63	9.85	2.31	4.28	3.55	1.87	13.84	3.60	.89	65.09	50.12	12.43	17.50	75,652	6.3
1374	Snoma	274	Md	1905 (1)	9.24	90.76	3.94	12.31	9.60	2.36	5.72	4.75	2.50	9.87	2.57	.64	68.16	52.48	13.01	18.41	79,586	6.8
1377	.....do	274	...do	....	8.45	91.55	2.91	14.13	11.02	2.59	6.75	5.60	2.95	8.66	2.25	.56	67.55	52.01	12.90	19.00	82,137	6.7
227	Big Four	178	Ill	....	6.72	93.28	3.73	11.25	8.77	2.06	4.58	3.80	2.00	15.03	3.91	.97	65.41	50.37	12.49	17.52	75,739	7.2
228	White Russian	285	N. Dak	....	6.35	93.65	3.49	13.94	10.87	2.55	6.03	5.00	2.63	10.69	2.78	.69	65.85	50.70	12.57	18.44	79,716	5.9
264	Black Hungarian	168	Nebr	1902	9.12	90.88	5.37	12.44	9.70	2.28	5.60	4.65	2.45	15.74	4.09	1.01	60.85	46.85	11.62	17.36	75,047	6.3
265	Ligowo	208	Minn	1902	10.05	89.95	3.27	11.12	8.67	2.04	5.21	4.32	2.27	10.44	2.71	.67	64.96	50.02	12.40	17.38	75,134	7.2

TABLE XXXIX.—*Emmer—individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N×6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1041	Black emmer	2337	France	Original	8.92	91.08	3.88	12.00	9.00	2.11	1.47	1.04	0.55	10.72	4.72	1.17	71.93	53.95	13.38	17.21	74,399	6.8
1040	.....do	2337	Md	....	9.01	90.99	3.30	13.94	10.45	2.46	1.81	1.28	.67	14.74	6.48	1.61	66.21	49.66	12.31	17.05	73,707	5.6
1042	.....do	2337	Kans	1905 (1)	8.25	91.75	5.60	12.62	9.46	2.22	2.88	2.04	1.07	17.89	7.87	1.95	61.01	45.76	11.35	16.59	71,718	6.1
1043	.....do	2337	Tex	1905 (1)	8.34	91.66	4.16	12.06	9.04	2.12	1.48	1.05	.55	12.54	5.52	1.37	69.76	52.32	12.97	17.01	73,534	6.7
1044	.....do	2238	Kans	1903 (1)	8.16	91.84	4.18	16.87	12.65	2.97	1.67	1.19	.63	10.33	4.55	1.13	66.95	50.21	12.45	17.18	74,269	4.5
1045	.....do	2238	...do	1904 (2)	8.27	91.73	4.87	17.12	12.84	3.02	1.94	1.38	.73	11.32	4.98	1.23	64.75	48.56	12.04	17.02	73,577	4.4
1046	.....do	2238	...do	1905 (3)	8.94	91.06	5.17	12.00	9.00	2.11	2.08	1.48	.78	11.21	4.93	1.22	69.54	52.15	12.93	17.04	73,664	6.7
1047	.....do	2238	Nebr	1903 (1)	8.22	91.78	4.96	12.87	9.65	2.27	1.95	1.38	.73	11.38	5.01	1.24	68.84	51.63	12.80	17.04	73,664	6.2
1048	.....do	2238	...do	1903 (1)	8.35	91.65	5.09	16.37	12.28	2.89	1.72	1.22	.64	11.06	4.87	1.21	65.76	49.32	12.23	16.97	73,361	4.6
1049	.....do	2238	N. Dak	1902 (1)	8.47	91.53	3.25	13.00	9.75	2.29	1.90	1.35	.71	10.67	4.69	1.16	71.18	53.39	13.24	17.40	75,220	6.3
1050	.....do	2238	...do	1905	8.49	91.51	3.74	11.25	8.44	1.98	2.05	1.46	.77	11.19	4.92	1.22	71.77	53.83	13.35	17.32	74,874	7.3
1051	.....do	2238	S. Dak	1903 (1)	8.85	91.15	3.86	18.69	14.02	3.29	1.43	1.02	.54	10.27	4.52	1.12	65.75	49.31	12.23	17.18	74,269	4.0
1052	.....do	2238	Colo	1903 (1)	8.77	91.23	4.57	12.06	9.04	2.12	1.74	1.24	.65	9.49	4.18	1.04	72.14	54.10	13.42	17.23	74,485	6.7
1053	.....do	2238	Tex	1902 (1)	9.60	90.40	4.27	14.56	10.92	2.57	1.77	1.26	.66	9.31	4.10	1.02	70.09	52.57	13.04	17.29	74,745	5.4
1054	.....do	2238	...do	1903 (1)	8.70	91.30	4.09	15.00	11.25	2,64	1.76	1.25	.66	11.16	4.91	1.22	67.99	50.99	12.64	17.16	74,183	5.2
1055	.....do	2238	...do	1904 (2)	8.24	91.76	4.10	14.44	10.83	2.54	1.83	1.30	.68	11.49	5.06	1.25	68.14	51.10	12.67	17.14	74,096	5.4
1056	.....do	2238	Minn	1902 (1)	10.25	89.75	4.79	11.81	8.86	2.08	1.87	1.33	.70	10.14	4.46	1.11	71.39	53.55	13.28	17.17	74,226	6.9
1057	.....do	2238	...do	1903 (1)	9.65	90.35	3.67	12.56	9.42	2.21	1.85	1.31	.69	10.05	4.42	1.10	71.87	53.90	13.37	17.37	75,090	6.5
1058	.....do	2238	...do	1904 (2)	8.69	91.31	4.24	11.81	8.86	2.08	1.93	1.37	.72	10.80	4.75	1.18	71.22	53.42	13.25	17.23	74,485	6.9
1059	.....do	2238	Wis	1902 (1)	7.97	92.03	2.46	13.06	9.79	2.30	1.93	1.37	.72	11.72	5.16	1.28	70.83	53.12	13.17	17.47	75,523	6.3
1060	.....do	2238	Ark	1903 (1)	8.14	91.86	3.27	12.87	9.65	2.27	2.03	1.44	.76	11.30	4.97	1.23	70.53	52.90	13.12	17.38	75,134	6.3
1061	.....do	2238	Pa	1902 (1)	8.60	91.40	2.61	10.44	7.83	1.84	2.29	1.63	.86	11.03	4.85	1.20	73.63	55.22	13.69	17.59	76,041	8.1
1062	.....do	2238	...do	1903 (2)	8.85	91.15	3.17	8.63	6.47	1.52	2.02	1.43	.75	12.02	5.29	1.31	74.16	55.62	13.79	17.37	75,090	9.9
1063	.....do	2238	N. Mex	1902 (1)	9.02	90.98	3.69	12.94	9.71	2.28	1.95	1.38	.73	9.17	4.03	1.00	72.25	54.19	13.44	17.45	75,436	6.3
1064	.....do	2238	Nebr	1904 (2)	8.19	91.81	4.64	12.00	9.00	2.11	1.93	1.37	.72	10.86	4.78	1.19	70.57	52.93	13.13	17.15	74,139	6.7

TABLE XL.—*Einkorn — individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry Matter.	Ash.	Protein (N× 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
							Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1065	2433	Kans.	1905 (1)	7.86	92.14	6.82	16.25	12.19	2.86	2.14	1.52	0.80	13.15	5.79	1.44	61.64	46.23	11.46	16.56	71,589	4.5
1066	2433	S. Dak.	1905 (2)	8.78	91.22	5.69	13.75	10.31	2.42	2.18	1.55	.82	14.67	6.45	1.60	63.71	47.78	11.85	16.69	72,451	5.6
1067	2433	....do	1905 (2)	8.81	91.19	5.04	15.00	11.25	2.64	2.00	1.42	.75	13.39	5.89	1.46	64.57	48.43	12.01	16.86	72,886	5.1
1068	2433	Tex.	1905 (1)	7.91	92.09	4.72	13.69	10.27	2.41	2.43	1.73	.91	13.01	5.72	1.42	66.15	49.61	12.30	17.04	73,664	5.8

TABLE XLI.—*Wheat — individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Locality.	Water.	Dry matter.	Ash.	Protein (N× 5.7)			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
						Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
	Durum	Russia	11.02	88.98	1.78	16.87	14.17	3.33	2.25	1.42	0.75	2.40	1.13	0.28	76.56	70.50	17.50	21.86	94,501	5.3
	T. vulgare	....do	9.43	90.57	1.85	16.76	14.07	3.31	1.72	1.08	.57	2.45	1.15	.28	77.22	71.04	17.62	21.76	94,068	5.3
	T. sativum	India	9.58	90.42	2.30	11.97	10.05	2.36	2.62	1.65	.87	3.06	1.44	.36	80.05	73.65	18.26	21.85	94,457	7.8
	Durum	United States.	9.77	90.23	2.02	15.50	13.02	3.06	2.73	1.72	.91	2.83	1.33	.33	76.92	70.77	17.55	21.85	94,457	5.8
	N. W. spring	....do	10.11	89.89	1.85	14.02	11.78	2.77	2.24	1.41	.74	2.59	1.17	.29	79.39	73.04	18.11	21.91	94,717	6.6
	Kans. winter	....do	10.68	89.32	2.28	13.17	11.06	2.60	1.81	1.14	.60	2.79	1.31	.32	79.95	73.55	18.24	21.76	94,068	7.0
	Soft winter	....do	10.55	89.45	2.00	11.86	9.96	2.34	1.91	1.20	.63	2.49	1.17	.29	81.77	75.24	18.66	21.92	94,760	7.9

TABLE XLII.—*Rye — individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N× 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1069	....	30	Md........	1906	9.37	90.63	2.27	13.06	10.97	2.58	1.84	1.18	0.62	2.47	1.31	0.32	80.36	73.93	18.33	21.85	94,457	7.1
1070	Ivanov..................	34	Kans......	1905 (1)	9.92	90.08	2.36	17.44	14.65	3.44	1.75	1.12	.59	2.44	1.29	.32	76.01	69.92	17.34	21.69	93,766	5.0
1071	.....do..................	34	...do.......	1905 (1)	9.49	90.51	2.28	13.75	11.55	2.71	1.87	1.20	.63	2.66	1.41	.35	79.44	73.09	18.13	21.82	94,328	6.7
1072	.....do..................	34	...do.......	1905 (1)	9.14	90.86	2.23	11.12	9.34	2.19	1.93	1.24	.65	2.48	1.31	.32	82.24	75.66	18.76	21.92	94,760	8.5
1073	.....do..................	34	...do.......	1905 (1)	9.75	90.25	2.33	12.62	10.59	2.49	2.17	1.39	.73	2.38	1.26	.31	80.50	74.06	18.37	21.90	94,674	7.4
1074	.....do..................	34	Tex........	1905 (1)	9.18	90.82	1.65	11.87	9.97	2.34	1.78	1.14	.60	2.23	1.18	.29	82.47	75.87	18.81	22.04	95,279	8.0
1075	.....do..................	34	Wyo.......	1905 (1)	8.87	91.13	2.08	10.50	8.82	2.07	1.54	.99	52	2.17	1.15	.28	83.71	77.01	19.10	21.79	94,976	9.1
1076	Abbruzzes...............	40	Kans......	1905 (1)	9.42	90.58	2.27	15.62	13.12	3.08	1.68	1.08	.57	2.29	1.21	.30	78.14	71.89	17.83	21.78	94,155	5.8
1077	.....do..................	40	Cal........	1905 (1)	9.26	90.74	2.09	13.31	11.18	2.63	1.77	1.13	.59	2.15	1.14	.28	80.68	74.22	18.41	21.91	94,717	7.0
1085	.....do..................	40	...do.......	1905 (1)	9.09	90.91	2.09	10.75	9.03	2.12	1.98	1.27	.67	2.16	1.14	.28	83.02	76.38	18.94	22.01	95,149	8.9
1078	.....do..................	40	Tex........	1905 (1)	9.13	90.87	1.65	15.44	12.97	3.05	1.77	1.13	.59	2.07	1.10	.27	79.07	72.75	18.04	21.95	94,890	5.9
1079	.....do..................	40	Oreg.......	1904 (1)	8.88	91.12	3.06	12.19	10.24	2.41	1.95	1.25	.66	2.53	1.34	.33	80.27	73.85	18.32	21.72	93,895	7.6
1080	Spring..................	73	Nebr.......	1905 (1)	9.87	90.13	2.12	11.37	9.55	2.24	1.93	1.24	65	2.39	1.27	.31	82.19	75.61	18.75	21.95	94,890	8.3
1081	.....do..................	73	...do.......	1905 (2)	9.42	90.58	1.95	14.19	11.92	2.80	1.91	1.22	.64	2.20	1.17	.29	79.75	73.37	18.19	21.92	94,760	7.1
1082	.....do..................	73	...do.......	1905 (1)	9.55	90.45	2.32	16.44	13.81	3.25	1.71	1.09	.57	2.22	1.18	.29	77.31	71.12	17.64	21.75	94,025	5.4
1083	.....do..................	73	...do.......	1905 (1)	9.78	90.22	2.17	15.19	12.76	3.00	1.84	1.18	.62	2.17	1.15	.28	78.63	72.34	17.94	21.84	94,414	6.0
1084	.....do..................	73	...do.......	1905 (1)	9.30	90.70	2.13	13.69	11.50	2.70	1.73	1.11	.58	2.16	1.14	.28	80.29	73.87	18.32	21.88	94,587	6.7

TABLE XLIII.—*Barley — individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N×6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1124	Hanna	226	Ariz.	1905 (1)	8.94	91.06	2.55	11.06	7.74	1.82	2.09	1.86	0.98	4.40	1.45	0.36	79.90	73.51	18.23	21.39	92,469	10.2
1125	do	287	Kans.	1905 (2)	9.63	90.37	2.90	15.44	10.81	2.54	2.09	1.86	.98	4.46	1.47	.36	75.11	69.10	17.14	21.02	90,869	6.9
1126	do	301	do	1905 (2)	9.54	90.46	3.35	14.31	10.02	2.35	2.13	1.90	1.00	4.42	1.46	.36	75.79	69.72	17.29	21.00	90,783	7.5
1127	do	305	do	1905 (2)	9.25	90.75	3.36	16.00	11.20	2.63	2.14	1.90	1.00	4.63	1.53	.38	73.87	67.96	16.85	20.86	90,178	6.6
1128	do	318	do	1905 (2)	9.59	90.41	3.14	14.75	10.32	2.43	2.07	1.84	.97	3.94	1.30	.33	76.10	70.01	17.36	21.09	91,172	7.3
1129	Tennessee winter	257	do	1905 (2)	9.57	90.43	3.56	13.12	9.18	2.16	1.98	1.76	.93	5.90	1.95	.48	75.44	69.40	17.21	20.78	89,832	8.2
1130	do	257	do	1905 (2)	9.18	90.82	3.63	12.75	8.92	2.10	2.20	1.96	1.03	5.77	1.90	.47	75.65	69.60	17.26	20.86	90,178	8.5
1131	do	257	do	1905 (2)	9.12	90.88	3.32	12.25	8.57	2.01	2.04	1.82	.96	5.87	1.94	.48	76.52	70.39	17.46	20.91	90,394	8.9
1132	do	257	do	1905 (2)	8.73	91.27	3.27	12.81	8.97	2.11	1.93	1.72	.90	5.21	1.72	.43	76.78	70.63	17.52	20.96	90,610	8.5
1133	do	257	do	1905 (2)	9.65	90.35	3.23	14.06	9.83	2.31	1.83	1.63	.86	5.98	1.97	.49	74.90	68.91	17.09	20.75	89,702	7.6
1134	do	257	do	1905 (2)	10.00	90.00	3.47	11.37	7.96	1.87	2.00	1.78	.94	5.50	1.81	.45	77.66	71.45	17.72	20.98	90,696	9.7
1135	do	257	do	1905 (2)	8.82	91.18	3.42	11.75	8.22	1.93	1.84	1.64	.86	6.06	2.00	.50	76.93	70.77	17.55	20.84	90,091	9.3
1136	do	257	do	1905 (2)	8.82	91.18	3.24	12.62	8.83	2.07	2.00	1.78	.94	6.00	1.98	.49	76.14	70.04	17.37	20.87	90,221	8.6
1137	do	257	do	1905 (2)	9.19	90.81	2.93	14.44	10.11	2.38	1.91	1.70	.89	6.20	2.05	.51	74.52	68.55	17.00	20.78	89,832	7.3
1138	do	257	do	1905 (2)	9.10	90.90	3.37	13.62	9.53	2.24	1.74	1.55	.81	5.67	1.87	.46	75.60	69.55	17.25	20.76	89,745	7.9
1139	do	257	do	1905 (2)	9.18	90.82	3.37	12.25	8.57	2.01	1.91	1.70	.89	6.04	1.99	.49	76.43	70.31	17.44	20.83	90,048	8.9
1140	do	257	do	1905 (2)	9.16	90.84	3.30	12.87	9.01	2.12	2.00	1.78	.94	6.46	2.13	.53	75.37	69.34	17.20	20.79	89,875	8.4
1141	do	257	do	1905 (2)	8.87	91.13	3.01	15.50	10.50	2.47	1.79	1.59	.84	5.53	1.82	.45	74.17	68.24	16.92	20.68	89,400	7.0
1142	do	257	Tex.	1905 (1)	9.19	90.81	3.08	11.31	7.92	1.86	1.98	1.76	.93	6.10	2.01	.50	77.53	71.32	17.69	20.98	90,696	9.8
1143	do	257	Ind. Ter.	1905 (1)	9.17	90.83	2.71	16.75	11.72	2.75	2.00	1.78	.94	5.74	1.89	.47	72.80	66.97	16.61	20.77	89,789	6.2
1144	do	257	Md.	1904 (1)	12.37	87.63	2.33	12.19	8.53	2.00	0.59	.53	.28	6.33	2.09	.52	78.56	72.28	17.93	20.73	89,616	8.9
1145	do	257	do	1905 (2)	13.28	86.72	3.07	10.50	7.35	1.73	0.37	.33	.17	6.32	2.08	.52	79.74	73.36	18.19	20.61	89,097	10.4
1386	do	257	do	1906 (2)	9.36	90.64	2.52	12.31	8.62	2.03	2.01	1.79	.94	5.79	1.91	.47	77.37	71.18	17.65	21.09	91,172	10.1
1146	do	353	Kans.	1905 (1)	9.02	90.98	3.28	11.87	8.31	1.95	1.90	1.69	.89	7.19	2.37	.59	75.76	69.69	17.28	20.71	89,529	9.1
1147	do	353	do	1905 (1)	8.97	91.03	3.10	9.56	6.69	1.57	1.71	1.52	.80	5.82	1.92	.48	79.81	73.42	18.21	21.06	91,042	11.8
1148	do	353	Tex.	1905 (1)	9.34	90.66	3.07	14.50	10.15	2.39	1.71	1.52	.80	6.30	2.08	.52	74.42	68.46	16.98	20.69	89,443	7.3
1149	do	353	do	1905 (1)	9.07	90.93	3.23	14.56	10.19	2.40	1.73	1.54	.81	6.51	2.15	.53	73.97	68.05	16.88	20.62	89,140	7.2
1150	do	353	Nebr.	1905 (1)	9.41	90.59	3.40	12.37	8.66	2.04	1.68	1.50	.79	6.25	2.06	.51	76.30	70.19	17.41	20.75	89,702	8.7
1151	Swan Neck	187	Sweden	Original	9.36	90.64	3.04	13.94	9.76	2.29	2.18	1.94	1.02	4.06	1.34	.33	76.78	70.63	17.52	21.16	91,475	7.8
1153	do	187	Kans.	1905 (4)	9.49	90.51	2.65	16.50	11.55	2.71	2.26	2.01	1.06	4.30	1.42	.35	74.29	68.34	16.95	21.07	91,086	6.4
1154	do	187	S. Dak.	1904 (2)	8.70	91.30	2.80	14.81	10.37	2.44	2.14	1.90	1.00	4.15	1.37	.34	76.10	70.01	17.36	21.14	91,388	7.3
1155	do	187	do	1905 (3)	9.54	90.46	2.37	15.75	11.02	2.59	2.44	2.17	1.14	4.70	1.55	.38	74.74	68.76	17.05	21.16	91,475	6.8
1156	do	187	Wash.	1903 (1)	9.26	90.74	3.11	16.12	11.28	2.65	2.51	2.23	1.17	4.30	1.42	.35	73.96	68.04	16.87	21.04	90,956	6.6
1157	do	187	Cal.	1902 (2)	9.52	90.48	2.76	9.25	6.48	1.52	1.67	1.49	.78	5.13	1.69	.42	81.19	74.69	18.52	21.24	91,820	12.3

1152	Kitzing	189	Bavaria	Original	8.82	91.18	2.85	11.82	8.27	1.94	1.94	1.73	.91	4.15	1.37	.34	79.24	72.90	18.08	21.27	91,950	9.4
1158	....do	189	Kans	1905 (4)	9.20	90.80	2.80	15.81	11.07	2.60	1.96	1.74	.91	3.97	1.31	.32	75.46	69.42	17.22	21.05	90,999	6.7
1159	....do	189	S. Dak	1905 (3)	9.50	90.50	2.87	14.69	10.29	2.42	2.03	1.81	.95	4.75	1.57	.39	75.66	69.60	17.26	21.02	90,869	7.3
1160	Beldi	190	Kans	1903 (1)	8.92	91.08	3.05	14.00	9.80	2.30	1.77	1.58	0.83	7.29	2.41	.60	73.89	67.98	16.86	20.59	89,010	7.5
1161	....do	190	...do	1903 (2)	9.45	90.55	3.18	14.06	9.84	2.31	1.92	1.71	.90	6.74	2.22	.55	74.10	68.17	16.91	20.67	89,356	7.6
1162	....do	190	N. Dak	1905 (2)	8.92	91.08	3.03	15.50	10.85	2.55	2.01	1.79	.94	6.52	2.15	.53	72.94	67.10	16.64	20.66	89,313	6.7
1163	....do	190	S. Dak	1902 (1)	8.74	91.26	2.89	14.19	9.93	2.33	2.07	1.84	.97	6.74	2.22	.55	74.11	68.18	16.91	20.76	89,745	5.5
1164	....do	190	...do	1904 (2)	9.02	90.98	3.54	14.44	10.11	2.38	1.65	1.47	.77	8.07	2.66	.66	72.30	66.51	16.49	20.30	87,757	7.2
1165	....do	190	...do	1905 (3)	9.08	90.92	3.52	16.25	11.37	2.67	1.72	1.53	.80	7.83	2.58	.64	70.68	65.03	16.13	20.24	87,497	6.2
1166	....do	190	Texas	1904 (1)	9.03	90.97	2.97	12.31	8.62	2.03	1.84	1.64	.86	8.99	2.97	.74	73.89	67.98	16.86	20.49	88,578	8.7
1167	....do	190	Wash	1903 (1)	9.18	90.82	3.10	8.31	5.82	1.37	1.98	1.76	.93	6.87	2.27	.56	79.74	73.36	18.19	21.09	91,172	13.8
1168	....do	190	Cal	1903 (1)	8.55	91.45	3.39	12.75	8.92	2.10	2.18	1.94	1.02	6.29	2.08	.52	75.39	69.36	17.20	20.84	90,091	8.5
1169	....do	190	...do	1904 (2)	9.00	91.00	3.19	11.87	8.31	1.95	1.97	1.75	.92	6.78	2.24	.55	76.19	70.09	17.38	20.80	89,918	9.2
1170	....do	190	...do	1905 (1)	9.41	90.59	2.91	11.25	7.87	1.85	1.94	1.73	.91	6.29	2.08	.52	77.61	71.40	17.71	20.99	90,740	9.8
1171	....do	190	Ariz	1904 (1)	9.25	90.75	3.09	10.12	7.08	1.66	1.75	1.56	.82	6.91	2.28	.56	78.13	71.88	17.83	20.87	90,221	11.0
1172	Black Smyrna	191	Kans	1905 (2)	9.64	90.36	2.97	14.62	10.23	2.40	1.83	1.63	.86	6.22	2.05	.51	74.36	68.41	16.96	20.73	89,616	7.2
1173	....do	191	S. Dak	1903 (2)	9.25	90.75	3.20	16.62	11.63	2.73	1.88	1.67	.88	5.37	1.77	.44	72.93	67.09	16.64	20.69	89,443	6.2
1174	....do	191	...do	1904 (2)	9.60	90.40	2.97	14.44	10.11	2.38	1.73	1.54	.81	5.73	1.89	.47	75.13	69.12	17.14	20.80	89,918	7.4
1175	....do	191	...do	1905 (3)	9.66	90.34	2.83	14.06	9.84	2.31	1.75	1.56	.82	6.18	2.04	.51	75.18	69.18	17.16	20.80	89,918	7.6
1176	....do	191	...do	1904 (3)	9.29	90.71	2.71	17.94	12.56	2.95	2.17	1.93	1.02	5.38	1.78	.44	71.80	66.05	16.38	20.79	89,875	5.7
1177	....do	191	...do	1905 (1)	10.30	89.70	3.30	13.00	9.10	2.14	1.72	1.53	.80	6.11	2.02	.50	75.87	69.78	17.31	20.75	89,702	8.3
1178	....do	191	Wash	1903 (1)	9.94	90.06	3.31	15.31	10.72	2.52	1.83	1.63	.86	5.11	1.69	.42	74.44	68.48	16.98	20.78	89,832	6.9
1179	....do	191	Cal	1903 (1)	9.31	90.69	2.89	12.94	9.06	2.13	2.07	1.84	.97	4.84	1.60	.40	77.26	71.08	17.63	21.13	91,345	8.5
1180	....do	191	...do	1905 (2)	9.49	90.51	3.18	10.62	7.43	1.75	2.07	1.84	.97	6.34	2.09	.52	77.79	71.57	17.75	20.99	90,740	10.5
1181	....do	191	N. Mex	1905 (1)	9.00	91.00	3.14	10.31	7.22	1.70	1.81	1.61	.85	5.49	1.81	.45	79.25	72.91	18.08	21.08	91,129	10.8
1182	Princess	193	Kans	1905 (4)	9.98	90.02	3.18	16.25	11.37	2.67	1.77	1.58	.83	4.62	1.52	.38	74.18	68.24	16.92	20.80	89,918	6.4
1183	....do	193	S. Dak	1904 (2)	9.54	90.46	2.90	14.00	9.80	2.30	1.85	1.65	.87	4.31	1.42	.35	76.94	70.78	17.55	21.07	91,086	7.7
1184	....do	193	...do	1905 (3)	9.33	90.67	2.56	15.00	10.50	2.47	1.65	1.47	.77	4.75	1.57	.39	76.04	69.95	17.35	20.98	90,696	7.1
1185	....do	193	Cal	1902 (1)	9.37	90.63	2.78	8.44	5.91	1.39	1.66	1.48	.78	4.99	1.65	.41	82.13	75.56	18.74	21.32	92,166	13.6
1186	Telli	194	Kans	1903 (1)	8.42	91.58	3.36	15.31	10.72	2.52	1.64	1.46	.77	8.08	2.67	.66	71.61	65.88	16.34	20.29	87,714	6.7
1187	....do	194	...do	1905 (2)	9.53	90.47	3.58	15.50	10.85	2.55	1.76	1.57	.83	6.68	2.20	.55	72.48	66.68	16.54	20.47	88,492	6.7
1188	....do	194	N. Dak	1903 (2)	9.01	90.99	2.95	13.94	9.76	2.29	1.76	1.57	.83	7.98	2.63	.65	73.37	67.50	16.74	20.51	88,665	7.5
1189	....do	194	N. Mex	1904 (1)	9.48	90.52	2.73	11.50	8.05	1.89	1.89	1.68	.88	7.81	2.58	.64	76.07	69.98	17.35	20.76	89,745	9.5
1190	....do	194	S. Dak	1904 (2)	9.04	90.96	3.03	12.25	8.57	2.01	1.65	1.47	.77	8.55	2.82	.70	74.52	68.56	17.00	20.48	88,535	8.7
1191	....do	194	Mont	1902 (1)	9.84	90.16	2.60	12.06	8.44	1.98	1.64	1.46	.77	6.28	2.07	.51	77.42	71.22	17.66	20.92	90,437	9.1
1192	....do	194	Wash	1903 (1)	9.25	90.75	3.24	12.69	8.88	2.09	1.58	1.41	.74	6.45	2.13	.53	76.04	69.95	17.35	20.71	89,529	8.5
1193	....do	194	Cal	1903 (1)	8.54	91.46	3.30	11.50	8.05	1.89	1.67	1.49	.78	6.23	2.06	.51	77.30	71.11	17.63	20.81	89,962	9.5
1194	....do	194	...do	1904 (2)	8.83	91.27	2.98	11.00	7.70	1.81	1.67	1.49	.78	6.57	2.17	.54	77.78	71.56	17.75	20.88	90,264	10.0
1195	....do	104	...do	1904 (1)	8.15	91.85	2.79	13.87	9.71	2.24	1.49	1.33	.70	6.23	2.06	.51	75.62	69.57	17.25	20.74	89,659	7.6
1196	....do	194	Ariz	1905 (1)	8.54	91.46	2.95	13.00	9.10	2.14	1.60	1.42	.75	6.74	2.22	.55	75.71	69.65	17.27	20.71	89,529	8.2
1220	....do	194	...do	1904 (1)	8.14	91.86	2.66	14.31	10.02	2.35	1.83	1.63	.86	7.88	2.60	.64	73.32	67.45	16.73	20.58	88,967	7.4
1197	White Smyrna	195	Kans	1903	9.19	90.81	3.22	11.12	7.78	1.83	1.79	1.59	.84	5.58	1.84	.46	78.29	72.03	17.86	20.99	90,740	10.0
1198	....do	195	...do	1905 (2)	10.20	89.80	3.36	14.12	9.88	2.32	1.82	1.62	.85	5.22	1.72	.43	75.48	69.44	17.22	20.82	90,005	7.6
1199	....do	195	S. Dak	1904 (2)	9.44	90.56	2.87	12.56	8.79	2.07	1.71	1.52	.80	5.50	1.81	.45	77.36	71.17	17.65	20.97	90,653	8.7
1200	....do	195	...do	1905 (3	9.75	90.25	2.73	13.69	9.58	2.25	1.71	1.52	.80	5.66	1.87	.46	76.21	70.11	17.59	20.90	90,351	7.9
1201	....do	195	...do	1904 (3)	8.52	91.48	2.30	13.87	9.71	2.28	1.90	1.69	.89	4.75	1.57	.39	77.18	71.00	17.61	21.17	91,518	7.8
1202	....do	195	...do	1905 (4)	9.11	90.89	3.23	12.50	8.75	2.06	1.83	1.63	.86	5.69	1.88	.47	76.75	70.60	17.51	20.90	90,351	8.7
1203	....do	195	Wash	1903 (1)	8.89	91.11	2.90	13.94	9.76	2.29	2.02	1.80	.95	4.65	1.53	.38	76.49	70.37	17.45	21.07	91,086	7.7
1204	....do	195	Cal	1903 (1)	8.70	91.30	2.74	12.12	8.48	1.99	1.85	1.65	.87	4.73	1.56	.39	78.56	72.27	17.92	21.17	91,518	9.2
1205	....do	195	...do	1904 (2)	8.60	91.40	2.74	9.44	6.61	1.55	1.85	1.65	.87	5.07	1.67	.41	80.90	74.42	18.46	21.29	92,037	12.1
1206	....do	195	...do	1905 (1)	8.17	91.83	3.80	11.50	8.05	1.89	2.05	1.82	.96	6.34	2.09	.52	76.71	70.57	17.50	20.87	90,221	9.5
1207	Fan	255	France	Original	9.72	90.28	2.84	11.75	8.22	1.93	1.77	1.58	.83	4.50	1.48	.37	79.14	72.81	18.06	21.19	91,604	9.5

TABLE XLIII.—*Barley—individual analyses*—Continued.

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N×6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1208	Fan	255	S. Dak.	1905 (2)	9.59	90.41	3.03	14.62	10.23	2.40	1.79	1.59	0.84	5.04	1.66	0.41	75.72	69.48	17.23	20.88	90,264	8.3
1209	Marriout	261	do	1905 (2)	9.27	90.73	3.15	14.25	9.97	2.34	1.52	1.35	.71	7.42	2.45	.61	73.66	67.76	16.80	20.46	88,449	7.3
1210	do	261	Tex.	1905 (1)	8.91	91.09	3.36	11.69	8.18	1.92	1.64	1.46	.77	7.14	2.36	.58	76.17	70.07	17.37	20.64	89,227	9.3
1211	Manchuria	170	S. Dak.	1905 (3)	9.58	90.42	2.39	13.25	9.27	2.18	1.65	1.47	.77	6.47	2.14	.53	76.24	70.14	17.38	20.86	90,178	8.1
1212	do	170	do	1904 (2)	8.87	91.13	3.27	13.62	9.53	2.24	1.51	1.34	.70	7.16	2.36	.58	74.44	68.48	16.98	20.50	88,621	7.7
1213	do	170	Alaska	1903	8.31	91.69	3.34	9.75	6.82	1.60	1.71	1.52	.80	7.06	2.33	.58	78.14	71.89	17.81	20.79	89,875	11.4
1214	Sesolsk	89	Kans.	1905 (4)	8.30	91.70	3.49	15.06	10.54	2.48	1.81	1.61	.85	5.76	1.90	.47	73.88	67.97	16.86	20.66	89,313	7.0
1215	Giant Winter	30	Oreg.	1904 (2)	8.93	91.07	2.24	9.37	6.56	1.54	1.44	1.28	.67	2.23	.74	.18	74.72	77.94	19.33	21.72	93,815	12.4
1216	Hull-less	197	Wash.	1903 (1)	8.92	91.08	2.42	18.69	13.08	3.07	2.31	2.06	1.08	2.76	.91	.23	73.82	67.91	16.84	21.22	91,734	5.6
1217	Hull-less Hankin	197	Kans.	1903	8.64	91.36	2.58	20.63	14.44	3.39	1.94	1.73	.91	2.81	.93	.23	72.04	66.27	16.44	20.97	90,653	4.9
1218	Hull-less Nepal	321	S. Dak.	1905 (2)	9.45	90.55	2.23	15.56	10.89	2.56	1.81	1.61	.85	2.73	.90	.22	77.67	71.46	17.72	21.35	92,296	7.0
1219	Mexican Beardless	352	do	1905 (2)	9.41	90.59	2.34	16.19	11.33	2.66	1.99	1.77	.93	2.67	.88	.22	76.81	70.66	17.52	21.33	92,209	6.7
1086	Black Arabian	202	Arabia	Original	9.30	90.70	2.89	13.06	9.14	2.15	1.87	1.66	.87	5.98	1.97	.49	76.20	70.10	17.38	20.89	90,307	8.3
1087	do	263	England	do	9.44	90.56	2.52	12.31	8.62	2.03	1.99	1.77	.93	4.94	1.63	.40	78.24	71.98	17.85	21.21	91,691	9.0
1088	do	264	do	do	9.51	90.49	2.74	13.75	9.62	2.26	2.25	2.00	1.05	4.50	1.48	.37	76.76	70.61	17.51	21.19	91,604	8.0
1089	do	265	do	do	9.46	90.54	2.99	13.12	9.18	2.16	2.35	2.09	1.10	4.45	1.47	.36	77.09	70.92	17.59	21.21	91,691	8.4
1090	do	266	do	do	9.44	90.56	2.63	10.37	7.26	1.71	2.11	1.88	.99	4.09	1.35	.33	80.80	74.33	18.43	21.46	92,771	11.0
1091	do	202	Ariz.	1905 (1)	9.38	90.62	2.94	12.06	8.44	1.98	1.59	1.42	.75	6.09	2.01	.50	77.32	71.13	17.64	20.87	90,221	9.0
1092	do	263	Kans.	1905 (2)	10.11	89.89	3.24	15.31	10.72	2.52	1.85	1.65	.87	5.43	1.79	.44	74.17	68.24	16.92	20.75	89,702	6.9
1093	do	264	do	1905 (2)	9.96	90.04	3.24	17.62	12.33	2.90	2.07	1.84	.97	4.59	1.51	.37	72.48	66.68	16.54	20.78	89,832	5.9
1094	do	264	Wash.	1905 (2)	9.06	90.94	2.98	9.13	6.39	1.50	2.32	2.06	1.08	4.22	1.39	.34	81.35	74.84	18.56	21.48	92,858	12.6
1095	do	265	do	1905 (2)	9.33	90.67	3.21	12.75	8.92	2.10	2.22	1.98	1.04	4.41	1.46	.36	77.41	71.21	17.66	21.16	91,475	8.6
1096	do	265	Kans.	1905 (2)	9.73	90.27	3.39	17.37	12.16	2.86	2.16	1.92	1.01	4.79	1.58	.39	72.29	66.50	16.49	20.75	89,702	5.9
1097	Hanna	203	N. Dak.	1902 (1)	9.65	90.35	3.17	16.69	11.68	2.74	1.95	1.74	.91	4.50	1.48	.37	73.69	67.79	16.81	20.83	90,048	6.3
1098	do	203	do	1902 (2)	9.11	90.89	2.67	13.81	9.67	2.27	2.15	1.91	1.00	4.70	1.55	.38	76.67	70.53	17.49	21.14	91,388	7.9
1099	do	203	do	1903 (3)	9.19	90.81	3.14	11.62	8.13	1.93	2.25	2.00	1.05	4.60	1.52	.38	78.39	72.12	17.89	21.33	91,777	9.6
1100	do	203	S. Dak.	1903 (2)	9.58	90.42	3.41	14.87	10.41	2.45	2.37	2.11	1.11	4.45	1.47	.36	74.90	68.91	17.09	21.01	90,826	7.2
1101	do	203	do	1904 (2)	9.24	90.76	2.53	15.62	10.93	2.57	1.73	1.54	.81	4.87	1.61	.40	75.25	69.23	17.17	20.95	90,567	6.8
1102	do	203	do	1904 (3)	9.11	90.89	3.13	19.94	13.61	3.22	1.97	1.75	.92	4.48	1.48	.37	70.48	64.84	16.08	20.59	89,010	5.2
1103	do	203	do	1905 (3)	9.86	90.14	2.33	13.31	9.32	2.19	1.97	1.75	.92	4.65	1.53	.38	77.74	71.52	17.74	21.23	91,777	8.3
1104	do	203	do	1905 (4)	9.82	90.18	3.36	12.37	8.66	2.04	1.73	1.54	.81	4.32	1.43	.35	78.22	71.96	17.85	21.05	90,999	8.9
1105	do	203	Idaho	1903 (2)	9.48	90.52	3.27	11.00	7.70	1.81	1.68	1.50	.79	4.61	1.52	.38	79.44	73.08	18.12	21.10	91,215	10.1
1106	do	203	Minn.	1901 (1)	9.54	90.46	3.00	15.81	11.07	2.60	1.72	1.53	.80	4.73	1.56	.39	74.74	68.76	17.05	20.84	90,091	6.7
1107	do	203	do	1902 (2)	8.75	91.25	2.64	17.19	12.03	2.83	1.92	1.71	.90	4.54	1.50	.37	73.71	67.81	16.82	20.92	90,437	6.1
1108	do	203	Cal.	1902 (1)	9.20	90.80	2.97	14.06	9.84	2.31	1.92	1.71	.90	4.66	1.54	.38	76.39	70.27	17.43	21.02	90,869	7.7
1109	do	203	do	1902 (1)	9.14	90.86	2.62	15.81	11.07	2.60	1.93	1.72	.90	5.21	1.72	.43	74.43	68.48	16.98	20.91	90,394	6.7

1110	.....do..................	203	...do......	1903 (1)	9.97	90.03	2.87	10.19	7.13	1.68	2.02	1.80	.95	4.76	1.57	.39	80.16	73.74	18.29	21.31	92,123	11.1
1111	.....do..................	203	...do......	1904 (3)	9.35	90.65	2.80	9.75	6.82	1.60	2.05	1.82	.96	5.23	1.73	.43	80.17	73.76	18.29	21.28	91,993	11.7
1112	.....do..................	203	Mont......	1902 (1)	9.59	90.41	2.92	9.94	6.96	1.64	1.69	1.50	.79	4.44	1.47	.36	81.01	74.52	18.48	21.27	91,950	11.4
1113	.....do..................	203	...do......	1903 (2)	9.77	90.23	2.90	13.37	9.36	2.20	1.83	1.63	.86	4.50	1.48	.37	77.40	1.20	17.66	21.09	91,172	8.2
1114	.....do..................	203	N. H......	1903 (3)	9.51	90.49	2.42	10.44	7.31	1.72	1.81	1.61	.85	4.64	1.53	.38	80.69	74.23	18.41	21.36	92,339	10.9
1115	.....do..................	203	Tenn.....	1901 (1)	9.38	90.62	3.07	13.00	9.10	2.14	2.21	1.97	1.04	4.52	1.49	.37	77.20	71.02	17.61	21.16	91,475	8.5
1116	.....do..................	203	...do......	1902 (1)	9.52	90.48	3.03	12.44	8.71	2.05	2.02	1.80	.95	4.96	1.64	.41	77.55	71.34	17.69	21.10	91,215	8.8
1117	.....do..................	226	Kans......	1905 (3)	10.01	89.99	3.58	17.25	12.07	2.84	1.91	1.70	.89	4.66	1.54	.38	72.60	66.79	16.56	20.67	89,356	6.0
1118	.....do..................	226	Iowa......	1904 (1)	9.28	90.72	2.91	12.87	9.01	2.12	1.83	1.63	.86	4.62	1.52	.38	77.77	71.55	17.74	21.10	91,215	8.5
1119	.....do..................	226	S. Dak....	1903 (1)	9.16	90.84	3.13	14.46	10.12	2.38	1.96	1.74	.91	5.13	1.69	.42	75.22	69.20	17.16	20.87	90,221	7.4
1120	.....do..................	226	...do......	1904 (2)	9.21	90.79	2.67	13.00	9.10	2.14	1.96	1.74	.91	5.03	1.66	.41	77.37	71.18	17.65	21.11	91,258	8.4
1121	.....do..................	226	Wash.....	1903 (2)	9.84	90.16	3.26	16.31	11.42	2.68	2.00	1.78	.94	4.81	1.59	.39	73.62	67.73	16.80	20.81	89,962	6.4
1122	.....do..................	226	Texas.....	1905 (2)	9.24	90.76	3.02	13.62	9.53	2.24	1.92	1.71	.90	4.78	1.58	.39	76.66	70.52	17.49	21.02	90,869	8.0
1123	.....do..................	226	Mont.....	1903 (1)	9.73	90.27	3.01	12.00	8.40	1.97	2.08	1.85	.97	4.87	1.61	.40	78.04	71.79	17.80	21.14	91,388	9.2

TABLE XLIV.—*Proso—individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Locality.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N × 6.25).			Fat.			Crude fiber			Carbohydrate.			Total production value.		Nutritive ratio.
								Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
1037	Red Orenburg	21	Kans	1905 (2)	10.56	89.44	3.92	12.69	6.24	1.47	3.51	2.70	1.42	8.83	6.03	1.50	71.05	60.53	15.01	19.40	83,866	11.7
1002	do	21	do	1904 (1)	8.70	91.30	3.70	13.12	6.45	1.51	3.32	2.55	1.34	7.77	5.31	1.32	72.09	61.42	15.23	19.40	83,866	11.2
1003	do	21	do	1904 (2)	8.30	91.70	3.61	17.94	8.83	2.07	3.18	2.45	1.29	9.34	6.38	1.58	65.93	56.17	13.93	18.87	81,575	7.7
1004	do	21	Iowa	1903 (1)	8.67	91.33	3.43	13.87	6.82	1.60	3.00	2.31	1.22	8.13	5.55	1.38	71.57	60.98	15.12	19.32	83,520	10.5
1005	do	21	do	1904 (2)	8.71	91.29	2.78	13.44	6.61	1.55	3.33	2.56	1.35	9.29	6.34	1.57	71.16	60.63	15.03	19.50	84,298	11.0
1006	do	21	Nebr	1904 (2)	8.96	91.04	3.62	12.62	6.21	1.46	3.77	2.90	1.53	8.01	5.47	1.36	71.98	61.32	15.21	19.56	84,558	11.9
1007	do	21	do	1905 (2)	9.06	90.94	3.65	11.06	5.44	1.28	3.52	2.71	1.43	7.99	5.46	1.35	73.78	62.86	15.59	19.65	84,947	13.7
1008	do	21	do	1905 (2)	9.30	90.70	4.85	12.50	6.15	1.45	3.26	2.51	1.32	9.71	6.63	1.64	69.68	59.36	14.72	19.13	82,699	11.6
1009	do	21	N. Dak	1904 (1)	8.44	91.56	3.71	12.37	6.09	1.43	3.54	2.72	1.43	10.87	7.42	1.84	69.51	59.22	14.69	19.39	83,823	11.9
1010	do	21	do	1905 (2)	10.93	89.07	3.32	10.94	5.38	1.26	3.36	2.58	1.36	8.72	5.96	1.48	73.66	62.76	15.56	19.66	84,990	13.9
1011	do	21	Idaho	1904 (1)	8.61	91.39	3.91	11.44	5.63	1.32	2.98	2.29	1.20	9.39	6.41	1.59	72.28	61.58	15.27	19.38	83,780	13.1
1012	do	21	do	1904 (2)	8.33	91.67	3.73	11.81	5.81	1.37	2.93	2.25	1.18	9.77	6.67	1.65	71.76	61.14	15.16	19.36	83,695	12.5
1013	do	21	do	1905 (3)	9.54	90.46	3.94	11.37	5.59	1.31	3.28	2.52	1.33	9.13	6.24	1.55	72.28	61.58	15.27	19.46	84,126	13.1
1014	do	21	Colo	1903 (1)	8.58	91.42	3.42	14.81	7.29	1.71	3.43	2.68	1.39	4.58	3.13	.78	73.76	62.84	15.58	19.46	84,126	9.9
1015	do	21	do	1904 (2)	8.24	91.76	3.35	15.81	7.78	1.83	2.99	2.30	1.21	6.65	4.54	1.13	71.20	60.66	15.04	19.21	83,045	9.0
1016	do	21	Okla	1904 (1)	8.16	91.84	3.03	10.44	5.14	1.21	3.33	2.56	1.35	8.34	5.70	1.41	74.86	63.78	15.82	19.79	85,552	14.6
1017	do	21	do	1905 (2)	9.60	90.40	3.15	12.00	5.90	1.39	3.29	2.53	1.33	9.11	6.22	1.54	72.45	61.74	15.31	19.57	84,601	12.5
1018	Red Voronezh	26	Nebr	1904 (1)	8.55	91.45	3.22	11.87	5.84	1.37	3.48	2.68	1.41	9.85	6.73	1.67	71.58	60.98	15.12	19.57	84,601	12.7
1019	do	26	Kans	1904 (1)	8.97	91.03	3.69	13.00	6.40	1.50	3.18	2.45	1.29	9.34	6.38	1.58	70.79	60.31	14.96	19.33	83,564	11.2
1038	do	26	do	1905 (2)	10.79	89.21	3.71	11.00	5.41	1.27	3.17	2.44	1.28	8.94	6.11	1.52	73.18	62.34	15.46	19.53	84,428	13.6
1020	do	26	Idaho	1904 (1)	8.15	91.85	4.50	15.25	7.50	1.76	3.02	2.32	1.22	10.50	7.17	1.78	66.73	56.85	14.10	18.86	81,532	9.2
1021	do	26	do	1905 (2)	9.41	90.59	4.82	10.00	4.92	1.16	3.02	2.32	1.22	10.03	6.85	1.70	72.13	61.45	15.24	19.32	83,520	14.9
1022	do	26	Okla	1904 (1)	8.17	91.83	4.62	16.87	8.30	1.95	2.97	2.28	1.20	9.85	6.73	1.67	65.69	55.96	13.88	18.70	80,840	8.2
1023	do	26	Wash	1904 (1)	8.37	91.63	4.78	11.81	5.81	1.37	3.12	2.40	1.26	10.16	6.94	1.72	70.13	59.75	14.82	19.17	82,872	12.4
1024	do	26	do	1905 (2)	8.90	91.10	3.20	15.94	7.84	1.84	2.88	2.21	1.16	7.92	5.41	1.34	70.06	59.69	14.80	19.14	82,742	9.0
1025	do	26	Tex	1904 (1)	8.17	91.83	3.70	11.94	5.87	1.38	2.97	2.28	1.20	10.89	7.44	1.85	70.50	60.06	14.89	19.32	83,520	12.3
1026	Black Voronezh	27	Nebr	1904 (1)	8.99	91.01	3.44	11.37	5.59	1.31	3.70	2.85	1.50	7.58	5.18	1.28	73.91	62.97	15.62	19.71	85,206	13.3
1027	do	27	Idaho	1904 (1)	8.21	91.79	3.94	11.44	5.63	1.32	3.41	2.62	1.38	7.83	5.35	1.33	73.38	62.52	15.50	19.53	84,428	13.2
1028	do	27	do	1904 (1)	8.88	91.12	4.18	11.69	5.75	1.35	3.45	2.65	1.39	10.24	6.99	1.73	70.44	60.01	14.88	19.35	83,650	12.7
1029	do	27	Colo	1904 (1)	8.47	91.53	2.95	11.69	5.75	1.35	3.38	2.60	1.37	6.76	4.62	1.15	75.22	64.09	15.89	19.76	85,422	13.0
1030	do	27	Okla	1904 (1)	9.13	90.87	3.17	12.87	6.33	1.49	3.18	2.45	1.29	8.90	6.08	1.51	71.88	61.24	15.19	19.48	84,212	11.6
1031	do	27	Wash	1905 (1)	9.32	90.68	3.84	12.00	5.90	1.39	3.19	2.45	1.29	8.61	5.88	1.46	72.36	61.65	15.29	19.43	83,996	12.4
1032	do	27	Tex	1903 (1)	8.35	91.65	3.25	16.37	8.05	1.89	3.14	2.41	1.27	8.69	5.93	1.47	68.55	58.40	14.48	19.11	82,612	8.7
1033	do	27	do	1905 (2)	9.50	90.50	3.69	12.75	6.27	1.47	3.22	2.48	1.30	8.82	6.02	1.49	71.52	60.93	15.11	19.37	83,736	11.5

1034	.....do....................	27	...do......	1904 (1)	8.57	91.43	4.05	11.69	5.75	1.35	3.24	2.49	1.31	10.15	6.93	1.72	70.87	60.38	14.97	19.35	83,650	12.7
1035	.....do....................	27	Utah......	1904 (1)	8.54	91.46	5.65	10.87	5.35	1.26	3.36	2.58	1.36	10.82	7.39	1.83	69.30	59.04	14.64	19.09	82,526	13.4
1036	Yellow Manitoba..........	27	Kans......	1905 (2)	10.69	89.31	3.93	11.56	5.69	1.34	3.78	2.91	1.53	9.86	6.73	1.67	70.87	60.38	14.97	19.51	84,342	12.9
1001	.....do....................	27	...do......	1904	8.39	91.61	4.27	15.19	7.47	1.76	3.26	2.51	1.32	8.79	6.00	1.49	68.49	58.35	14.47	19.04	82,310	9.4

TABLE XLV.—*Sorghum—individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Variety.	Grain investigation No.	Water.	Dry matter.	Ash.	Protein (N × 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
						Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
768	Edra....................................	8815	10.91	89.09	2.18	11.44	7.44	1.75	4.34	3.04	1.60	1.73	0.88	0.22	80.31	73.08	18.12	21.69	93,766	10.9
769	Gidjep-jowar..........................	9855	11.02	88.98	1.64	10.13	6.58	1.55	3.30	2.31	1.22	1.57	.80	.20	83.36	75.86	18.81	21.78	94;155	12.5
770	Daydi-jowar...........................	9856	11.35	88.65	1.75	8.87	5.77	1.36	2.41	1.69	.89	1.66	.85	.21	85.31	77.64	19.25	21.71	93,852	14.3
771	Natal....................................	10327	10.91	89.09	1.60	14.50	9.42	2.21	2.97	2.08	1.09	1.94	.99	.25	78.99	71.88	17.83	21.38	92,426	8.2
772	Djuggara	10612	11.35	88.65	2.04	13.81	8.98	2.11	3.52	2.46	1.29	1.66	.85	.21	79.96	72.76	18.05	21.66	93,636	8.8
777	White Milo............................	2523	12.80	87.20	1.67	11.12	7.23	1.70	2.65	1.85	.97	2.12	1.08	.27	82.44	75.02	18.60	21.54	93,174	11.1
779	White Kafir...........................	1993	12.10	87.90	1.97	12.94	8.41	1.98	2.82	1.97	1.03	2.32	1.18	.29	79.95	72.75	18.04	21.34	92,253	9.3
780	.....do..................................	13317	12.55	87.45	1.65	11.56	7.51	1.76	3.33	2.33	1.23	1.78	.91	.23	81.68	74.32	18.43	21.65	93,593	10.7
781	Red Kafir..............................	13318	12.31	87.69	1.51	10.06	6.54	1.54	3.73	2.61	1.37	1.56	.79	.20	83.13	75.65	18.76	21.87	94,544	12.5
782	Dwarf Milo............................	13565	11.84	88.16	1.54	12.69	8.25	1.94	3.41	2.39	1.26	1.65	.84	.21	80.71	73.45	18.22	21.63	93,506	9.7

TABLE XLVI.—*Maize—individual analyses.*

[Pounds per hundred pounds of dry matter.]

Laboratory No.	Year and crop.	Water.	Dry matter.	Ash.	Protein (N × 6.25).			Fat.			Crude fiber.			Carbohydrate.			Total production value.		Nutritive ratio.
					Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Total.	Digestible.	Production value—gain in flesh.	Gain in flesh.	Calories.	
983	1906	12.98	87.02	1.56	9.69	6.98	1.64	4.13	3.68	1.94	2.19	1.27	0.31	82.43	78.31	19.42	23.31	100,769	12.6
984	1906	12.84	87.16	1.47	9.25	6.66	1.57	4.89	4.35	2.29	2.25	1.31	.32	82.14	78.03	19.35	23.53	101,720	13.4
985	1906	13.09	86.91	1.47	8.50	6.12	1.44	4.59	4.09	2.15	2.51	1.46	.36	82.93	78.78	19.54	23.49	101,547	14.6
986	1906	13.17	86.83	1.52	9.69	6.98	1.64	4.72	4.20	2.20	2.31	1.34	.33	81.76	77.67	19.26	23.43	101,287	12.6
987	1906	13.15	86.85	1.54	8.50	6.12	1.44	4.21	3.75	1.97	2.10	1.22	.30	83.65	79.46	19.71	23.42	101,245	14.5
988	1906	13.08	86.92	1.54	6.98	6.98	1.64	4.23	3.76	1.98	1.85	1.07	.26	82.69	78.55	19.48	23.36	100,985	12.6
989	1906	12.88	87.12	1.52	11.19	8.06	1.89	4.74	4.22	2.22	2.07	1.20	.30	80.48	76.45	18.96	23.37	101,028	10.8
990	1906	12.89	87.11	1.63	12.19	8.78	2.06	4.65	4.14	2.18	2.33	1.35	.33	79.20	75.24	18.66	23.23	100,423	9.8
991	1906	13.15	86.85	1.45	8.88	6.39	1.50	4.28	3.81	2.00	2.36	1.37	.34	83.03	78.87	19.56	23.40	101,158	13.9
992	1906	13.38	86.62	1.55	12.25	8.82	2.07	3.54	3.15	1.66	2.04	1.18	.29	80.62	76.59	18.99	23.01	99,472	9.6
993	1906	13.30	86.70	1.38	10.19	7.34	1.72	4.31	3.84	2.02	2.20	1.28	.32	81.92	77.82	19.30	23.36	100,985	11.9
994	1906	12.79	87.21	1.58	8.94	6.44	1.51	4.52	4.02	2.11	2.27	1.32	.33	82.69	78.55	19.48	23.43	101,287	13.8

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